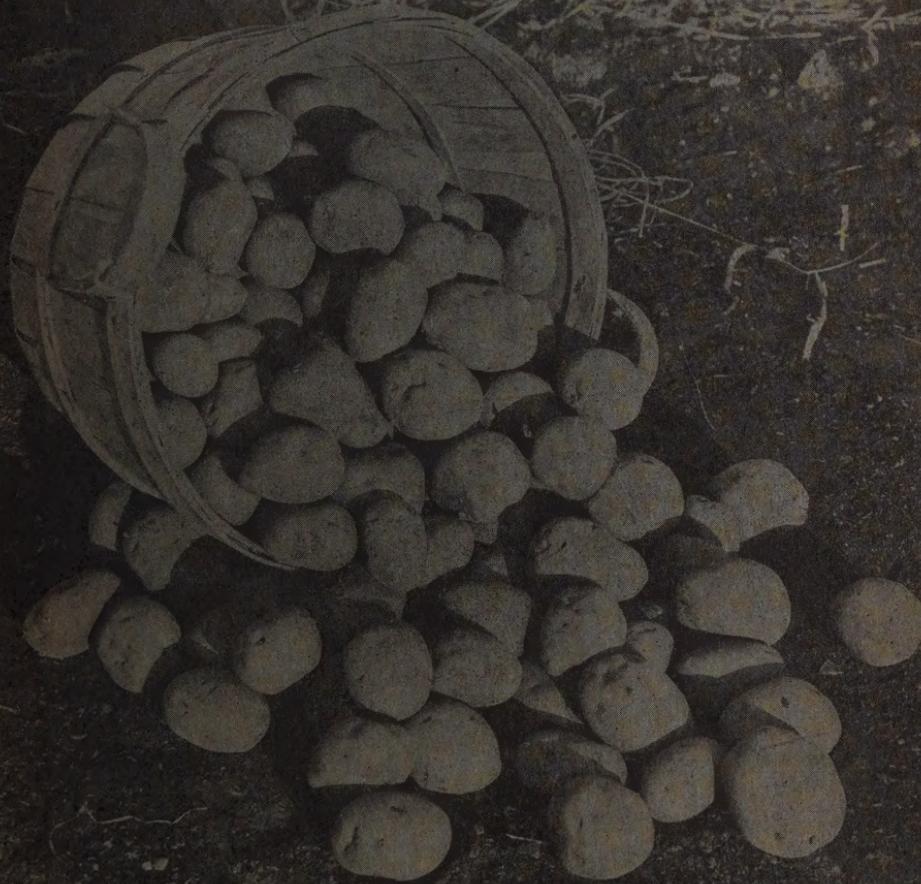


MINNESOTA FARMERS INSTITUTE ANNUAL

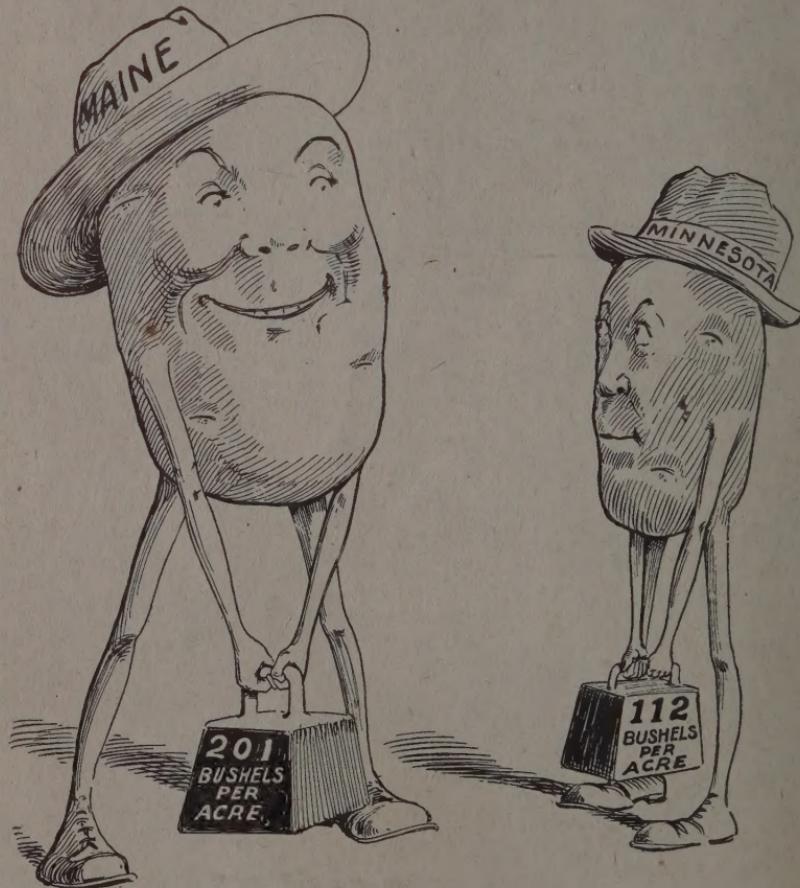


POTATO NUMBER
Nº 32 ~ 1919

HISTORICAL INTEREST
articles by G. R. BISCH

MAINE'S AVERAGE POTATO YIELD FOR TEN YEARS
HAS BEEN 201 BUSHELS TO THE ACRE.

MINNESOTA'S AVERAGE POTATO YIELD FOR TEN
YEARS HAS BEEN 112 BUSHELS TO THE ACRE.



WHAT MAINE CAN DO
MINNESOTA CAN DO

WITH—

SEED SELECTION
DISEASE CONTROL
PROPER CULTIVATION AND
SOIL TREATMENT

*With Compliments of
Bisby and Tolosa.*

Minnesota Farmers' Institute Annual

NUMBER 32, 1919

EDITED BY

A. D. WILSON

Director of Minnesota Farmers' Institutes and Agricultural
Extension Division

University Farm, St. Paul, Minnesota

AND

J. M. DREW

School of Agriculture, University of Minnesota
University Farm, St. Paul, Minnesota

Co-operation means so to conduct yourself that
others can work with you



(40,000 Copies Issued)

THE JENSEN PRINTING COMPANY
MINNEAPOLIS
1919

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OF MINNESOTA



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LETTER OF TRANSMITTAL

Hon. A. E. Rice, President of the Board of Administration of The Farmers' Institutes of Minnesota:

I transmit to you the following report of the work of the Farmers' Institutes for the year ending July 31, 1919.

Farmers' Institutes were held as follows:

Place	Date	Ses- sions	Atten- dance	Place	Date	Ses- sions	Atten- dance
—Waconia	Jan. 14-15	4	305	Aastad	Mar. 5	2	240
Chaska	Jan. 16	2	220	—Madelia	Mar. 5-6	4	770
—New Ulm	Jan. 17-18	4	580	—Vernon Center . . .	Mar. 5	2	285
—Winthrop	Jan. 20-21	4	445	—Chokio	Mar. 5	2	280
Hugo	Jan. 22	2	175	—Waldorf	Mar. 7	1	175
—Linwood	Jan. 23	2	275	—Maynard	Mar. 7-8	4	675
New Prague	Jan. 24	2	265	Clear Lake	Mar. 7	1	75
Belle Plaine	Jan. 25	2	300	—Becker	Mar. 8	2	190
—Glenwood	Jan. 27-28	4	350	—Rice	Mar. 10	2	175
—Clarkfield	Jan. 29-30	4	675	—Louisburg	Mar. 10	2	240
—Villard	Jan. 29-30	4	450	—Lucan	Mar. 12	2	255
—Canby	Jan. 31-Feb. 1	4	540	—Nassau	Mar. 12	1	160
—Evansville	Jan. 30-Feb. 1	4	250	—Spencer Brook . . .	Mar. 12	2	225
—Lake Benton	Feb. 3-4	4	440	—Milroy	Mar. 13	2	190
—Detroit	Feb. 3-4	4	450	—Boyd	Mar. 13	1	340
—Lake Park	Feb. 5-6	4	330	—Spring Lake	Mar. 13	2	180
—Worthington	Feb. 6-7	2	375	—Braham	Mar. 14	2	275
Halstad	Feb. 7-8	4	465	—Marshall	Mar. 14-15	4	310
—Plainview	Feb. 10-11	3	415	—Lamberton	Mar. 14-15	4	210
Sebeka	Feb. 11	2	600	Alexandria	Mar. 15	1	50
Menagha	Feb. 12	2	400	—Forest Lake	Mar. 15	2	115
—Goodhue	Feb. 13	1	125	Plummer	Mar. 17	1	35
—Wanamingo	Feb. 14	2	585	Shafer	Mar. 17	2	100
Hillman	Feb. 14	2	140	—Ewington	Mar. 17	2	300
—Lake City	Feb. 15	2	355	—Sioux Valley	Mar. 18	2	250
Freeborn	Feb. 17-18	4	550	Brooks	Mar. 18	1	35
—Scandia	Feb. 17-18	4	700	Lindstrom	Mar. 18	2	130
East Chain	Feb. 19	2	215	Blackduck	Mar. 18	2	65
Monterey	Feb. 20	2	375	Kelliher	Mar. 19	2	75
Truman	Feb. 21	2	170	Chisago City	Mar. 19	2	170
Madison Lake	Feb. 20-21	2	300	Saum	Mar. 20	2	90
Buffalo Lake	Feb. 25	2	375	—Granger	Mar. 20	2	255
Aldrich	Feb. 25	2	410	Quiring	Mar. 21	2	110
Bird Island	Feb. 26	2	320	—Solway	Mar. 22	2	210
—Underwood	Feb. 26-27	4	385	Clearbrook	Mar. 28	1	150
Franklin	Feb. 27	2	65	Cass Lake	Mar. 29	2	90
Watkins	Feb. 27-28	4	685	Williams	Mar. 31	2	175
Eden Valley	Feb. 28-Mar. 1	3	550	Baudette	Apr. 1	2	240
Mahnomen	Feb. 28-Mar. 1	5	290	Number of Institutes			79
Foley	Mar. 3-4	3	195	Number of Sessions			184
Ogilvie	Mar. 4	2	165	Total Attendance			23,155

Average per Institute.....	293
Average per Session.....	126

Institutes marked (—) were attended by a special home economics instructor.

Because of the influenza and the ban on public meetings it was impossible to start the regular Institute work before the middle of January. Institutes that had been scheduled before that date were cancelled, and at different times through the winter it was found necessary to cancel Institutes on the request of the local committees or the health authorities. This made it necessary to hold more one-day Institutes during the period available for Institute work. It will be noted that the attendance per Institute is slightly lower than last year, but the average attendance per session is higher. Reports from all sources indicate that the old-fashioned Institute still meets with favor among the farmers.

It had been planned to hold back enough of our Institute fund to allow for putting on a circuit of Institutes during the month of June. The Legislature, however, changed the date of the closing of the financial year from July 31st to June 30th, and we were required to turn back to the State one-twelfth of our last year's appropriation, leaving us without funds to do the work contemplated for June.

There is a constantly growing demand for help at special meetings arranged through County Agents and farmers' clubs. Where a County Agent has his work well organized, he is able to plan a series of meetings so that a representative of the Institute can hold meetings each afternoon and evening of the week, thoroughly covering all sections of the county. Instruction at such meetings is usually confined to the subject in which the people are most interested and in which the speaker is a specialist.

FINANCIAL STATEMENT

for the year ending June 30, 1919:

EXPENDITURES:

Aug. 31—	Gregg, O. C., August salary.....	\$83.33
	Minneapolis Paper Co., multigraph paper.....	61.00
	Palmer, Leona, August salary.....	75.00
	Remington Typewriter Co., typewriter.....	75.00
	Welch, C. H., August salary.....	150.00
Sept. 30—	Brown, C. E., services.....	175.00
	Gregg, O. C., September salary.....	83.33
	Palmer, Leona, September salary.....	75.00
	Welch, C. H. September salary.....	150.00
Oct. 31—	Gregg, O. C., October salary.....	83.33
	New England Furniture & Carpet Co., desk.....	51.75
	Palmer, Leona, October salary.....	83.33
	Schuneman & Evans, oilcloth.....	7.50
	Welch, C. H., October salary.....	166.66
Nov. 30—	Bugbee, L. H., services.....	80.00
	Gregg, O. C., November salary.....	83.33
	Palmer, Leona, November salary.....	83.33
	Welch, C. H., November salary.....	166.66
	Multigraph Sales Co., coupon book.....	50.00
	Grant & Sons, home economics equipment.....	10.20
	Graphic Electro Co., multigraph plates.....	6.05
	Rice, A. E., expense.....	8.57
	St. Paul Stamp Works, rubber stamps.....	3.30
	Wedelstaedt & Co., stapler and staples.....	6.50
	Welch, C. H., expense.....	8.20
Dec. 20—	Gregg, O. C., December salary.....	83.33
	Palmer, Leona, December salary.....	83.33
	Welch, C. H., December salary.....	166.66
Jan. 31—	Welch, C. H., January salary.....	166.66
	Palmer, Leona, January salary.....	83.33
	Gregg, O. C., January salary.....	83.33
	Sprenger, J. J., services.....	160.00
	Bugbee, L. H., services.....	80.00
	Brown, C. E., services.....	100.00
	Christgau, John, services.....	73.33
	Eastgate, J. E., services.....	100.00
	Patterson, C. D., services.....	30.00
	Bower, John, services.....	166.67
	Henry, Forest, services.....	141.67
	Laws, Mrs. B. D., services.....	141.67
	Bureau of Engraving, cover for Annual.....	25.00
	Graphic Electro Co., multigraph plates.....	3.68
Amount carried forward.....		\$3,515.03

Brought forward.....	\$3,515.03
Minneapolis Paper Co., paper and cards.....	97.50
Minnesota Engraving & Colorplate Co., half-tones and etchings for Annual.....	228.96
Remington Typewriter Co., repairs.....	11.70
Washington Electrotype Co., half-tones for Annual.....	30.75
Bugbee, L. H., expense.....	52.67
Glotfelter, C. W., expense.....	2.11
Ulrich, Edw. H., expense.....	4.96
Williams, M. M., expense.....	11.82
Feb. 28—Bugbee, L. H., services.....	160.00
Welch, C. H., February salary.....	166.66
Gregg, O. C., February salary.....	83.33
Palmer, Leona, February salary.....	83.33
Henry, Forest, services.....	200.00
Laws, Mrs. B. D., services.....	108.33
Christgau, John, services.....	160.00
Sprenger, J. J. services.....	160.00
Eastgate, J. E., services.....	200.00
Brown, C. E., expense.....	23.54
Bugbee, L. H., expense.....	85.15
Christgau, John, expense.....	75.93
Eastgate, J. E., expense.....	128.69
Sprenger, J. J., expense.....	52.42
Sprenger, J. J., expense.....	80.46
Mar. 31—Gregg, O. C., March salary.....	83.33
Palmer, Leona, March salary.....	83.33
Welch, C. H., March salary.....	166.66
Henry, Forest, services.....	150.00
Laws, Mrs. B. D., services.....	108.33
Christgau, John, services.....	120.00
Sprenger, J. J., services.....	93.33
Eastgate, J. E., services.....	150.00
Staples, L. D., services.....	80.00
Bugbee, L. H., services.....	120.00
Webb Publishing Co., Annual No. 31.....	4,903.00
Brown Printing Co., posters.....	85.05
Eastgate, J. E., expense.....	136.76
Henry, Forest, expense.....	234.45
Laws, Mrs. B. D., expense.....	167.21
Moberg, Nels, expense.....	46.15
Sprenger, J. J., expense.....	125.99
Welch, C. H., expense.....	20.60
April 30—Welch, C. H., April salary.....	166.66
Palmer, Leona, April salary.....	83.33
Gregg, O. C., April salary.....	83.33
Peters, H. J., services.....	22.50
Harrison, J. F., services.....	80.00
Moberg, Nels, services.....	70.00
Amount carried forward.....	\$13,103.35

Brought forward.....	\$13,103.35
Bugbee, L. H., services.....	140.00
U. S. Food Administration, paper.....	108.00
St. Paul Book & Stationery Co., blackboard.....	2.85
Wedelstaedt & Co., staples and paste.....	8.35
Bugbee, L. H., expense.....	71.27
Harrison, J. F., expense.....	52.52
Henry, Forest, expense.....	98.05
Laws, Mrs. B. D., expense.....	77.63
Moberg, Nels, expense.....	67.68
Staples, L. D., expense.....	48.89
May 31—Welch, C. H., May Salary.....	166.66
Gregg, O. C., May salary.....	83.33
Palmer, Leona, May salary.....	83.33
Christgau, John, expense.....	197.16
June 30—Welch, C. H., June salary.....	166.66
Palmer, Leona, June Salary.....	83.33
Gregg, O. C., June Salary.....	83.33
Farnham Printing & Stationery Co., filing case.....	44.15
	\$
Total expenditures.....	\$14,686.54
One-twelfth of appropriation to be returned to State, by reason of change in fiscal year.....	1,333.33
	\$
	\$16,019.87

Resources:

Balance July 31, 1918.....	\$38.81
Appropriation.....	16,000.00
	16,038.81
	\$
Balance June 30, 1919.....	\$ 18.94

Respectfully submitted,

A. D. Wilson,
Superintendent.

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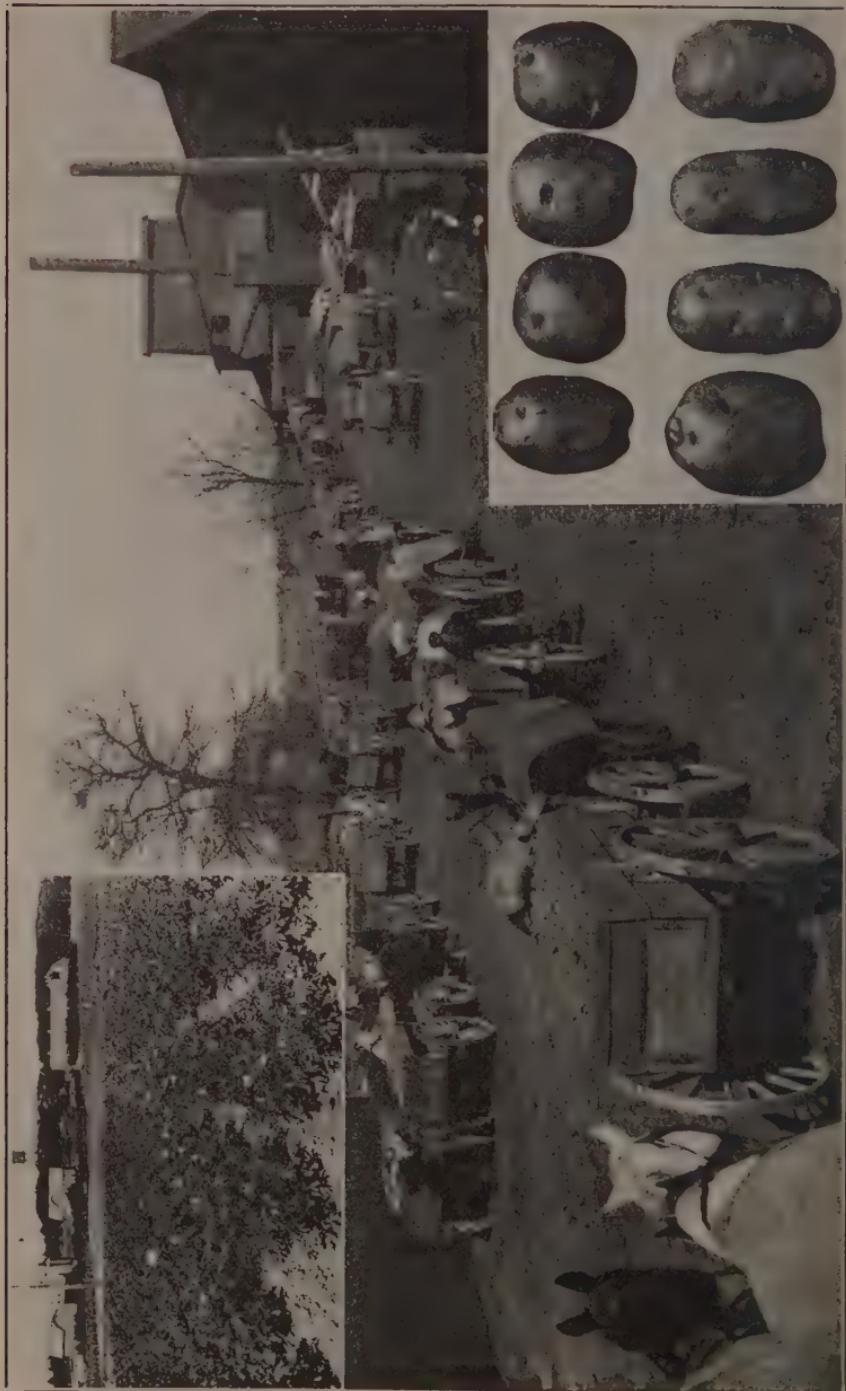
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MARKETING POTATOES AT NORTH BRANCH, MINN. INSERT, UPPER LEFT, FIELD OF POTATOES AT UNIVERSITY FARM.—INSERT, LOWER RIGHT, EIGHT STANDARD VARIETIES OF POTATOES RECOMMENDED FOR MINNESOTA. UPPER ROW LEFT TO RIGHT, EARLY OHIO, BLISS TRIUMPH, COBBLER, RURAL NEW-YORKER. BOTTOM ROW, LEFT TO RIGHT, KING, BURBANK, BURBANK RUSSET, GREEN MOUNTAIN.

Minnesota Farmers' Institute Annual

VOL.

NOVEMBER, 1919

XXXII

POTATOES IN MINNESOTA

By A. D. WILSON, UNIVERSITY FARM

Farmers' Institute Annual No. 32 is devoted quite largely to the potato crop. This crop is becoming one of the leading crops of the state. The acreage and yield per acre, the total yield, and farm value for the last ten years are shown below.

Potatoes are grown on practically every farm in the state. There are only a comparatively few sections of the state where potatoes are grown extensively as a cash crop. In some of these potato-growing sections remarkable progress has been made in growing and marketing the crop. The methods they have worked out so well in these communities should become general in all communities growing potatoes extensively. In other parts

of the state, where potatoes are grown merely for home use, there has been little development of the crop—very little care and thought are given to the selection of varieties, the control of disease, or to cultural methods. There is probably no other general farm crop in the state that offers such possibilities for improvement as the potato crop. The average yield of potatoes in the state is approximately 100 bushels per acre, while 600 bushels per acre is quite possible, as shown by the results of the boys' and girls' potato club work mentioned in another part of this annual. There is no question but that with proper attention to the selection of seed, to disease control, and cultural

Total Production of Irish Potatoes in the United States Each Year for Ten Years 1909 to 1918, inclusive; also average farm price December first each year and May first the following year.

Year	Production in millions of bushels	Total population of U. S. in millions	Bushel of potatoes per capita	Price received by producer;	
				Dec. 1 (Cents per bushel)	Following May 1, (Cents per bush.)
1909	389	92	4.2	54.1	38.4
1910	349	93.5	3.7	55.7	62.5
1911	292	95	3.1	79.9	127.3
1912	420	96.5	4.3	50.5	48.2
1913	331	98	3.4	68.7	71.4
1914	409	99.5	4.1	48.7	50.5
1915	359	101	3.5	61.7	94.8
1916	286	102.5	2.8	146.1	279.6
1917	442	104	4.2	122.8	80.1
1918	400	105.5	3.8	119.5	118.9
1919	349	107	3.3		

*Potatoes have
EYES*

*But they are
BLIND*

THEY are not so blind, though, as the POTATO GROWER who persists in growing his PET VARIETY regardless of the varieties grown by his

Neighbors

or DEMANDED by the MARKET.

methods, the yield of potatoes in this state may be doubled, or brought up to the yield secured on the average in the state of Maine, which for the ten years, 1909 to 1918, inclusive, amounted to 201 bushels per acre.

Potato Varieties

One of the handicaps under which the potato crop has been grown in the state is the multitude of varieties of potatoes. These have been developed largely through the initiative of seedsmen who have wanted a new sort of potato to advertise. They have simply made a selection from some old varieties and offered it for sale under a new name. This has led to great confusion with reference to the true varieties of potatoes. The Minnesota Potato Growers' Association several years ago, in co-operation with the potato specialists at University Farm, worked out and adopted as standard varieties in the state eight varieties, which are described and illustrated in another part of this Annual. This is a long step toward the standardization of the potato crop.

Many communities have, through their local potato growers' association, reduced the number of varieties grown generally to two, one early variety and one late variety. This we believe is a very desirable move. We believe that every potato grower, whether he is growing potatoes in a large way for market or in a small way for home use, should study these eight recommended varieties carefully and make up his mind which one or two varieties he will grow, establish firmly in his mind the type, and then stick to the variety or varieties chosen. This will be a valuable step in potato development.

Marketing Potatoes

Satisfactory marketing of potatoes, like the marketing of most of our farm products, has not developed very far as yet largely due to the fact that the marketing problem is usually a problem involving the interests of a large number of people, while production is a problem that in-

volves mainly the individual farm. Satisfactory marketing requires, first, a standardized product. This is very difficult to secure in a community until all, or a large number of the growers, agree to overcome their own personal preferences and adopt one or two varieties of potatoes to grow. So long as each one insists on growing his particular variety, the community is bound to have a mixed lot of potatoes which are difficult to dispose of. This insistence on independent action by individuals has greatly retarded the development of satisfactory plans of marketing potatoes. To insist on growing the particular sort of potatoes that appeals to one is really a short-sighted policy. The individual who is growing potatoes for market is not growing them for himself but for some one else. It should make no particular difference to him what the color, or shape, or character the potatoes might be so long as it is something that somebody else wants. I have often illustrated this point in this way, that the grower is not growing potatoes for himself but for the money he can get out of them. Consequently, he is not interested in the sort of potatoes but in the amount of money he will get for the crop. It is not difficult for a group of farmers to agree on the kind of money they want to take, so if they will look beyond the crop to the money, which is the real object of growing a crop, they can quite readily agree that the sort of potatoes that will yield best in the community and sell for the most money per acre is the sort they should all grow. This question can be quite easily settled by tests, or by making use of the combined experiences of the potato growers in the community.

Type of Potatoes to Grow

Judging from the potatoes exhibited at the county fairs and other crop shows in the state, one is forced to conclude that there is a great difference of opinion among growers as to what constitutes good potatoes. It is always assumed, of course,

that the exhibitor picks out what he considers the best potatoes from those he has on his farm, but some of the samples exhibited fall far short of possessing the qualities that one is looking for who is buying potatoes for home consumption. Potatoes are grown primarily for food and are chosen finally by the housewife who knows that she must prepare these potatoes for eating.

Peeling a Bushel of Potatoes

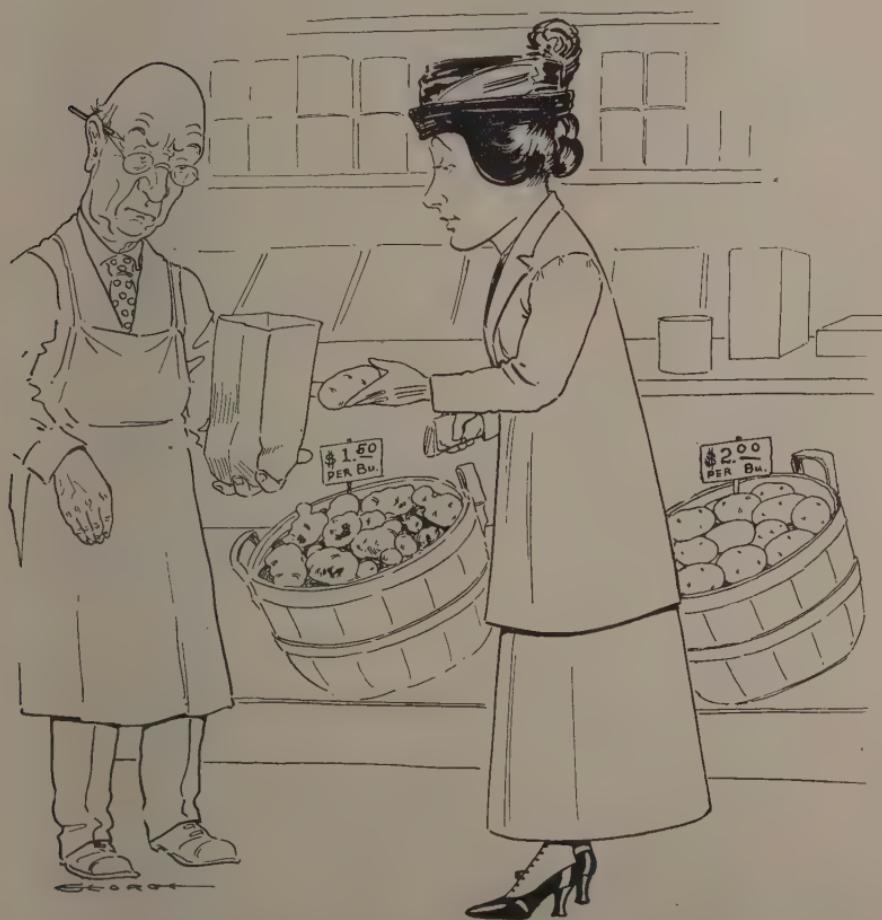
I have often said, in talking to potato growers, that I considered it very desirable that every potato grower before deciding on the particular type of potatoes he is to grow should sit down some stormy day and peel a bushel of potatoes. It is my conviction that the average potato grower would far rather grow a bushel of potatoes than to peel them. Yet, as a



THIS MAN HAS TAKEN THE ADVICE OF THE AGRICULTURAL COLLEGE TO PEEL A BUSHEL OF POTATOES AS A BASIS FOR FINDING OUT WHAT THE HOUSEWIFE WANTS WHEN SHE BUYS POTATOES. HE HAS CONCLUDED THAT HE WOULD RATHER RAISE A BUSHEL OF POTATOES THAN TO PEEL THEM

rule, he goes on growing them without a thought of pleasing the one who is to finally peel and use the potatoes. If one will but think of potatoes in this light, he will realize that the thoughtful purchase of potatoes is looking for potatoes that not only cook out well but that are easy to prepare. This means potatoes of medium size, as smooth as possible, without knobs or deep eyes, and free from scab and disease. The hill selection of potatoes

and the tuber unit method of improving potatoes, are worthy of very careful consideration by potato growers. These methods are described in another part of this Annual, but by this method one can develop potatoes of just about the sort he wishes to grow, and if he has in mind the pleasing of the ultimate consumer, he is likely to find a more ready market for his product.



"I WILL TAKE THE \$2.00 POTATOES. CONSIDERING THE WASTE AND THE EXTRA TIME NEEDED TO PEEL THOSE ROUGH POTATOES, THE OTHERS ARE CHEAPER.

Use More Potatoes

The producers of potatoes are, like the producers of every other product, interested in increasing the use of their particular product. Manufacturers of certain products spend a great deal of thought and energy, not only to produce a product that appeals to the consumer but to so put up that product that it is most conveniently handled by the consumer. Many of the breakfast foods that are sold at several times the cost of oat meal, are sold to the consumer merely through the method of making the product attractive and convenient to use. American consumers use very much fewer potatoes per capita than consumers in the European countries. This is undoubtedly due to the fact that the standard of living is somewhat higher here and because of our greater consumption of meats. However, I believe there is room for the producers of potatoes to increase the consumption of potatoes by giving thought to the housewife who uses the product. Every housewife has to plan a thousand or more times every year what the next meal shall be. There are many demands on her time from many sources. Many times there is barely time for the preparation of the meal between other important things that demand her time and thought. While I have never had the experience myself, I believe that the housewife runs over the list of things that she may have that are suitable for the family needs, and in making her selection she considers the time at her disposal and the time required for the preparation of the different articles of food. If she thinks of her potato bin as a receptacle filled with rough, scabby, deep-eyed, irregular potatoes, she is likely to pass on to some other product, or at least to have some hesitation about making potatoes the principal item of the coming meal. If she thinks of her potato bin as containing smooth, clean, medium sized, well selected potatoes that may be brushed off in a very short time and prepared for baking, or quickly peeled and prepared for boiling,

or even suitable for boiling with the jackets on, she is likely to go to that potato bin more times than she would if it presented the uninviting appearance mentioned above.

The Satisfied Customer

One of the very good slogans of modern business is the satisfied customer. Although the potato producer seldom deals directly with the ultimate consumer of potatoes, the fellow who sells to the ultimate consumer is made to know pretty thoroughly what she wants and he passes this on clear down the line to the farmer with the result that the farmer who has what is wanted is likely to get a much better price for his product than the fellow who has the undesirable product. The following story has been told with reference to marketing of potatoes and is repeated because it illustrates the point very well:

A Lesson in Farm Marketing

How One Producer Sold his Potatoes at a Higher Price

Two farm wagons stood in a public market, both loaded with bags of potatoes. A woman stopped before the first.

"How much are potatoes today?" she asked.

"Ninety cents a bushel," said the owner.

"Oh, my," exclaimed the woman. That seems high. I paid only 60 cents for the last."

"Taters've gone up," said the grower indifferently, and the woman went over to the second wagon and asked the same question. The owner's manner was in marked contrast.

"These are the best potatoes in the market, madam," he said. "Let me show them to you and tell you why. In the first place, I raise the kind with small eyes, so there'll be no waste in peeling—potatoes are too high nowadays to peel away. Then I sort them by sizes. In each bag you'll find a large size for boiling, frying and fancy shapes, and a medium size for baking. The baking size cooks quickly, all done at the same time and so saves coal or gas, whichever you use. We

washed all our potatoes clean at home, too. You could put one of these bags in your parlor and not soil the carpet—and you don't have to pay me for any dirt. I'm getting a dollar a bushel for them."

He sold her three bags.

Co-operative Marketing of Potatoes

The co-operative marketing of potatoes has not met with the general success that has attended the marketing of some of our other products. However, considerable progress has been made. Considerable mention is made of this in other parts of the Annual. We believe that the thing is going to be worked out finally in such a way that the potato crop will be handled with a much greater degree of satisfaction to producers than in the past. The fact that the crop is perishable, that it is a bulky, heavy crop of comparatively low value, has made the problem more difficult than that of handling some of the other farm products.

Minnesota potato growers will be interested in the plan of marketing potatoes that have been worked out in Michigan by the potato growers co-operating with the United States Department of Agriculture. This general plan is outlined elsewhere in this Annual. It really means a united effort on the part of the growers in a number of localities with facilities for somewhat standardizing the product, then finding out the markets where it is most needed and directing shipment to those markets and diverting shipments from markets that are, for the time being, overstocked. It also provides machinery for following shipments clear through un-

til they are sold and eliminating the possibility of a car of potatoes being rejected on some fake pretense that it is not up to grade, as is too commonly done with our present system of marketing, and when a car is rejected it is not always convenient for an individual co-operative potato shippers' association to follow the matter up and get justice. We believe the Michigan plan offers promise of marked improvement if it can be adapted to Minnesota conditions. Farmers in every potato-growing section of the state ought to familiarize themselves with this Michigan movement and then take the matter up, probably through the Minnesota Potato Growers' Association and the new State Department of Agriculture, with a view of working out this plan, or some other that will tend to do away with the present difficulties in potato marketing.

Future Possibilities

Minnesota is well adapted to the growing of potatoes. A splendid start has been made in the selection of varieties in their standardization throughout the state, in the control of disease, in the potato seed certification work, which is essentially the development of pure bred pedigreed potatoes; and some progress has been made in the marketing. There is room for much more development along all of these lines, but with the natural adaptability of the state for growing potatoes, not only for table stock but for seed stock in the Southern states, the potato industry offers a wonderful opportunity to people interested in this crop.

ASK THE CROP

BY DEAN R. W. THATCHER, UNIVERSITY FARM

There is a great and constantly growing demand for information as to how increased yields of crops can be produced on both the older, well developed lands of the southern part of the state and on the new lands which are being brought under cultivation further north. There are large numbers of land-owners who are anxious to get better or more profitable yields of crops from the lands which they cultivate. Among the possible ways of doing this, the use of commercial fertilizers is often thought of as a desirable one. This is usually the result of experience in older agricultural states where depletion of soil fertility has made the use of fertilizers a common practice or else of rumors of large profits which have been obtained from their use in nearby localities.

Are Fertilizers Profitable?

It seems to be the common practice of farmers who desire to use fertilizers to write to the state agricultural college or experiment station and ask for advice as to the kind and amount of fertilizer to use. Often a sample of soil is sent along with the request that it be "analyzed" to determine what fertilizing it needs. Unfortunately, the question as to whether a fertilizer can be used with profit on any particular farm and for any particular crop cannot be answered as easily as these inquirers expect. A chemical analysis of a soil may indicate what elements are present in it in small proportions and which may need replenishing in order to maintain the soil on a permanently productive basis, but it is obviously impossible for the chemist to tell from the results of an analysis whether the application of any fertilizer to the soil will give sufficient increase in the resulting crop to more than pay for the cost of using the fertilizer.

Two Kinds of Investigation

The soil expert endeavors to meet the need for this kind of information by two

series of investigations. First, he conducts some kind of a "survey" which gives him definite information as to the types of soil which are to be found in the district which he is studying, so that he will know what information gathered from experiments and analyses will apply to the particular type of soil on any farm. Then he proceeds to arrange for carefully conducted experiments with fertilizers on each of the different types of soil which are to be dealt with in his state or district, just as extensively as the facilities which he can get for this work will permit. After a few years of these field experiments he is generally able to say whether any given type of soil is likely to yield increased crops if fertilized with any of the common fertilizer materials which he has used in his experiments.

But even then he cannot, of course, tell whether the increased yield obtained in any given year upon any particular farm will be sufficiently valuable to produce a profitable return upon the money invested in the use of the fertilizer. This can only be determined by the individual farm owner by experiments on his own land with the particular crop which he wishes to raise.

Commercial Fertilizers Rarely Profitable in Minnesota

In general, it has been found that in Minnesota commercial fertilizers rarely produce profitable returns when used on the common field crops which yield even at their best only a relatively small crop of low or medium-priced products. For example, there would be little possibility of any large profit from fertilizing a wheat crop which yields only a few bushels per acre since the possible increase in yield due to the fertilizer would be worth only a few dollars at most. On the other hand, if the crop to be grown is one which requires intensive cultivation, like a root or truck crop, and which under favorable

conditions yields several hundred bushels per acre, it is often possible to secure sufficiently large increases in yield as a result of judicious use of fertilizers to make a handsome profit from the practice. Whether or not such a profit can be obtained on any given farm can only be determined by experiments conducted on that particular type of soil and under the conditions of growth and markets represented in that particular locality.

Potatoes are a crop which is particularly well adapted to such experiments; since if they respond to the fertilizer at all the resulting increase in yield is easily measured and the question of whether this increase is obtained at a profit is easily answered. Further, the application of the fertilizer to this crop is easily accomplished, it is easy to leave unfertilized rows or plots as a check to show how much increase if any is obtained on the fertilized rows, and easy to harvest and measure separately the yield from the

fertilized and the untreated parts of the field. Again, profitable results from fertilizers upon potatoes are often obtained, where the increased yield obtained on grain crops is not enough to justify the use of the fertilizer. This is because of the fact that potatoes and other root crops have the ability to make large use of liberal amounts of soluable plant food in the soil during their periods of rapid growth.

Potato-growers are, therefore, recommended to "ask the crop," by means of experiments, whether it will not yield profitable response to the application of plant food in the form of fertilizers. Experiment Station men will be glad to furnish suggestions as to the kinds and quantities of fertilizers to be used in such experiments and the precautions to be observed in order to be sure that the answer which the crop returns at harvest time is properly understood.

POTATO VARIETIES FOR MINNESOTA

A. W. AAMODT, BEMIDJI

Introduction

Efforts to standardize the Minnesota potato varieties during the past four or five years have met with most gratifying results. Before the eight standard potato varieties were recommended and adopted by the Minnesota Potato Growers' Association, the Minnesota Crop Improvement Association, and the University Department of Agriculture, an investigator could find from ten to fifty named varieties in most any community in the state except the potato counties in the Twin City district and the Red River Valley.

These districts had learned in the early years that one variety must be their choice and that the Early Ohio was the variety that the market demanded, also the variety they could grow successfully. Today they are growing this one variety almost exclusively and placing it on both the consuming and seed market.

The past few years we have learned that the Green Mountain (Carmen No. 1), a medium late variety, is the best all-around, year-in and year-out variety that can be grown in the north-central and north-eastern districts of Minnesota. It is a variety which finds a ready market as a table potato as well as a limited market as a seed potato in the southern half of Minnesota and in a few of the southern states.

The Rural Worker (Carmen No. 3), a late round white potato, is largely grown in the eastern and central districts of the state to be marketed for table stock. This variety and the Green Mountains have been called "Carmens" for so long a time that more or less confusion has resulted. However, the grower who will study the characteristics of these varieties need suffer no embarrassment because of mixture in his field.

The Burbank Russet as grown in the north-central district of the state has developed a strong demand in the various

consuming markets as a table potato, but it was not until last year or so that a demand has developed in some of the irrigation districts of the Western states for this variety as a seed potato. When grown a year in the west it is then put on the consuming market as the "Netted Gem."

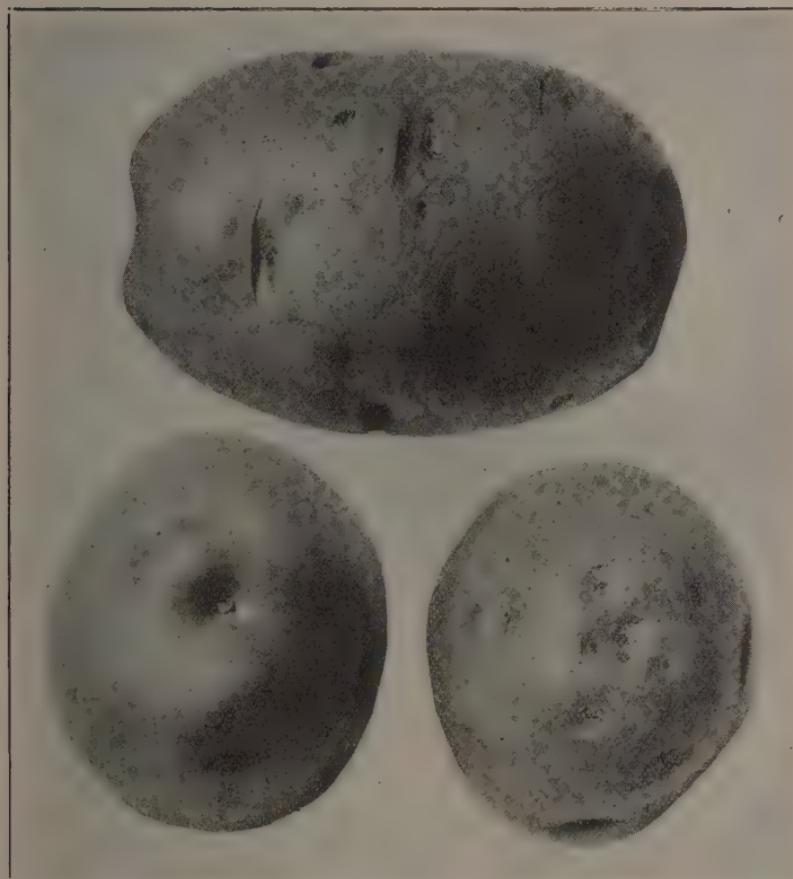
The Bliss Triumph and the Irish Cobbler are both early varieties which are grown almost exclusively for seed to be marketed in the Southern states. These varieties grow to perfection in the north-central and northeastern districts of the state.

The Burbank is a late long white potato which is grown only to supply the table demand and is usually found grown largely in the potato districts of central Minnesota.

The King is another late variety which is grown in various districts of the state, but during the last few years it has lost its popularity as a marketable potato.

Considerable confusion has been experienced among potato growers because of the various opinions as to the characteristics of the different varieties. It is often difficult for a person to identify any variety by simply examining the tubers. One should make a systematic study of not only the tuber but also the sprouts as they appear on the tuber, the foliage, and the blossoms. Three factors must be taken into consideration when studying potato varieties. The first and most essential is that different soils cause a variation in both color and type of any variety. Second, the season may cause a variation in type, and third, the condition the previous season may also cause a slight variation in the type.

The following descriptions and photographs will be of some assistance in identifying any one of the Minnesota eight standard varieties:



EARLY OHIO

Early Ohio (1)

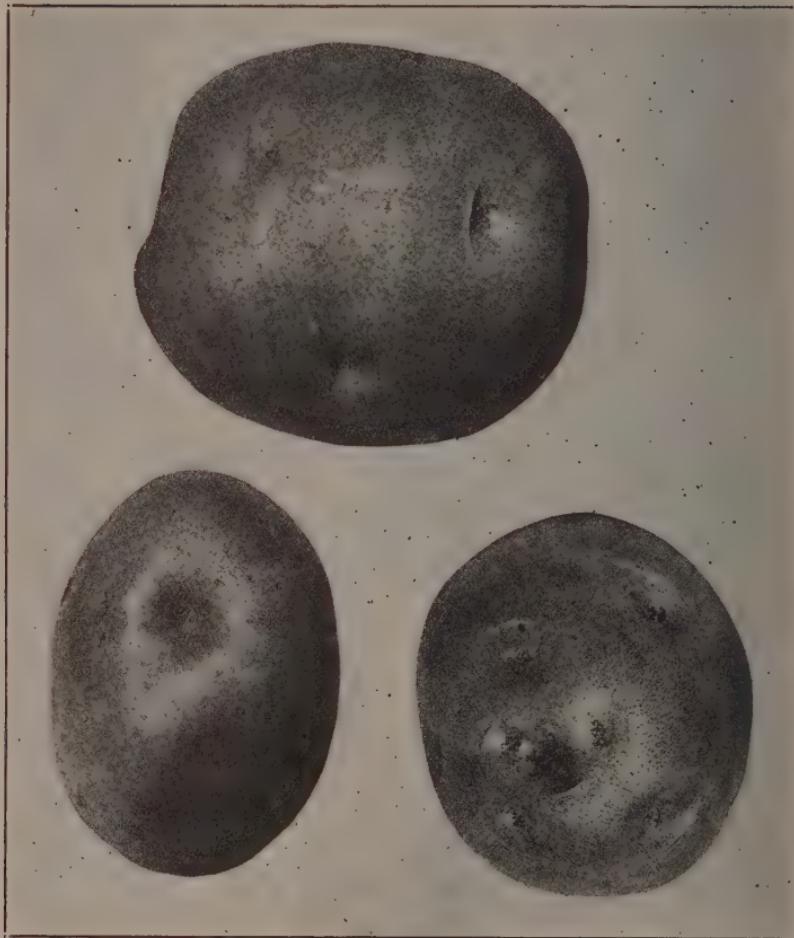
Tuber—Skin pinkish or flesh-colored with numerous full eyes which are fairly shallow to sometimes protuberant. Shape is oval to oval-oblong with roundish stem and seed ends.

Sprouts—Pinkish to red in color and stout.

Foliage—Large, bushy, considerably branched, light green stems tinged with purple, leaves medium dark green.

Blossoms—Medium in number; white.

Synonyms—Early Six Weeks, Ohio Junior, Acme, Early Market and Prize Early Dakota.



TRIUMPH

Triumph (2)

Tuber—Skin light to a solid red with fairly numerous medium deep eyes. Shape roundish, blocky, slightly flattened with ends depressed to form deep cavity.

Sprouts—Pink to red.

Foliage—Medium large, with stout stems, well branched, light green with purple tinge and dark green leaves.

Blossoms—Usually very few, light lavender.

Synonyms—Red Bliss, Bliss Triumph, and Stray Beauty.



IRISH COBBLER

Irish Cobbler (3)

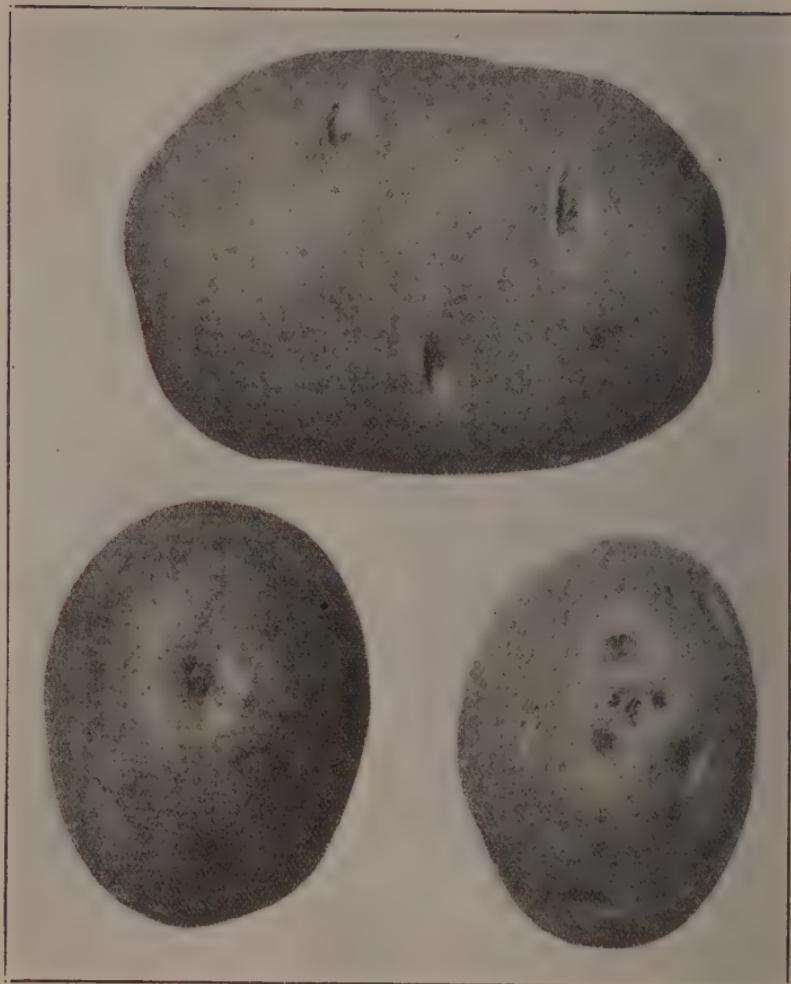
Tuber—Skin white, medium numerous and deep eyes, characterised by a prominent ridge at the eyebrows causing uneven surface. Shape roundish to roundish oval, slightly flattened, blocky, with deep ends.

Sprouts—Very stout, dark green tinged to a deep red.

Foliage—Medium large with numerous and stout stems which are medium light green with purplish tinge at nodes, dark green leaves.

Blossoms—Medium in number, slightly lavender fading to a whitish color at maturity.

Synonym—Early Eureka, Early Petosky, and Early Victor.



GREEN MOUNTAIN

Green Mountain (4)

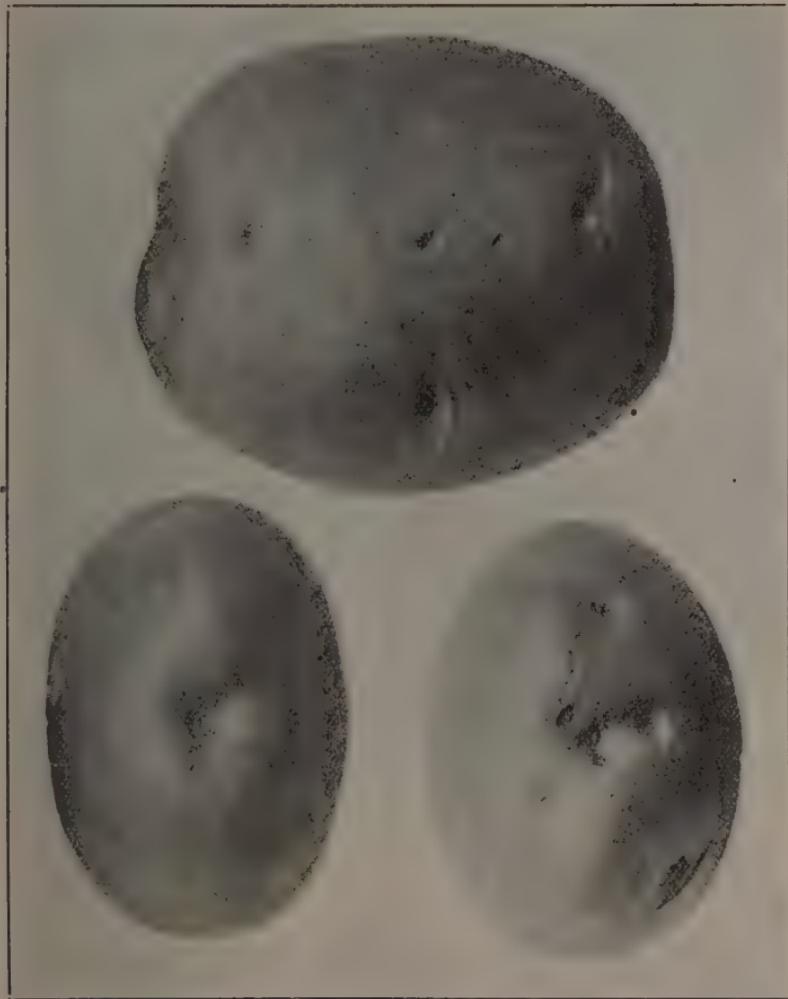
Tuber—Skin creamy white to white, usually flaked toward seed end with narrow eyes medium in number, size, and depth. Shape short and oblong, flattened, square shallow ends.

Sprouts—Distinctly light green, occasionally a faint pink tinge.

Foliage—Very large, bushy, mostly decumbent with light green stems and leaves.

Blossoms—Usually very abundant, white.

Synonyms—Carmen No. 1, Empire State, Gold Coin, Green Mountain, Jr., State of Maine, Norcross.



RURAL NEW YORKER

Rural New Yorker (5)

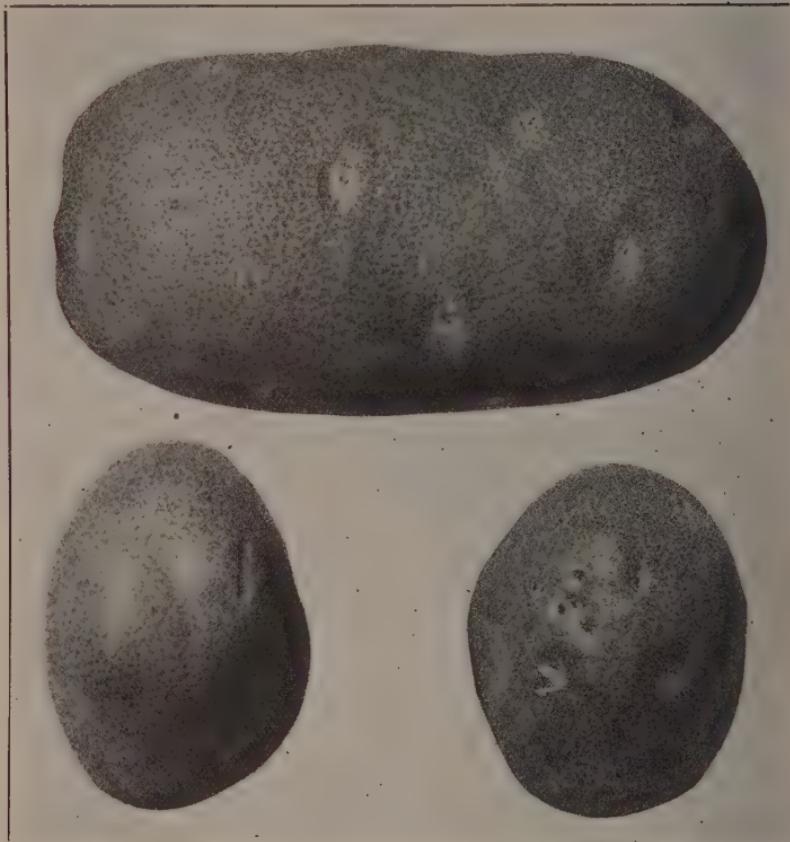
Tuber—Skin, white occasionally flaked at the seed end with fairly numerous eyes which are shallow and broad. Shape nearly round to round-oval, and considerably flattened with stem and seed ends roundish but occasionally medium deep.

Sprouts—Distinctly purple tipped.

Foliage—Large and spreading when full grown, stems at first are upright, dark green, heavily tinged with purple. Leaves dark green.

Blossoms—Usually very few or none, deep purple with white at tips of petals.

Synonyms—Carman No. 3, Sir Walter Raleigh, and Rural New Yorker No. 2.



BURBANK RUSSET

Burbank Russet (6)

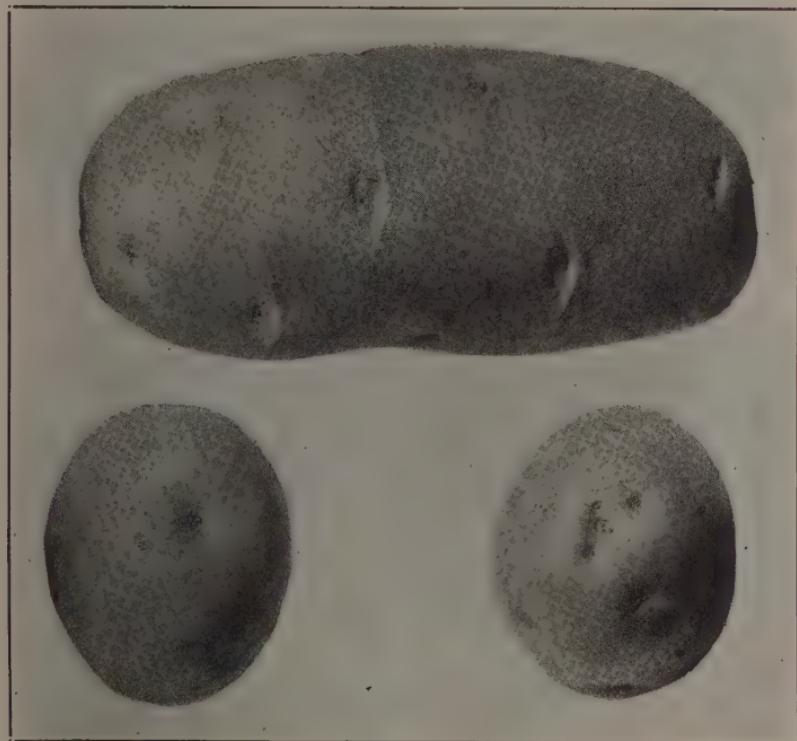
Tuber—Skin yellowish russet with medium number of inconspicuously shallow to nearly protuberant eyes. Shape long, elliptical, slightly flattened with roundish ends.

Sprouts—Greenish with a pink or carmine tinge.

Foliage—Large, bushy, numerous stems of light green color, tinged with purple. Leaves medium dark green.

Blossoms—Fairly numerous, white with considerable yellow at base of petals.

Synonyms—California Russet, Cambridge Russet, and Netted Gem.



BURBANK

Burbank (7)

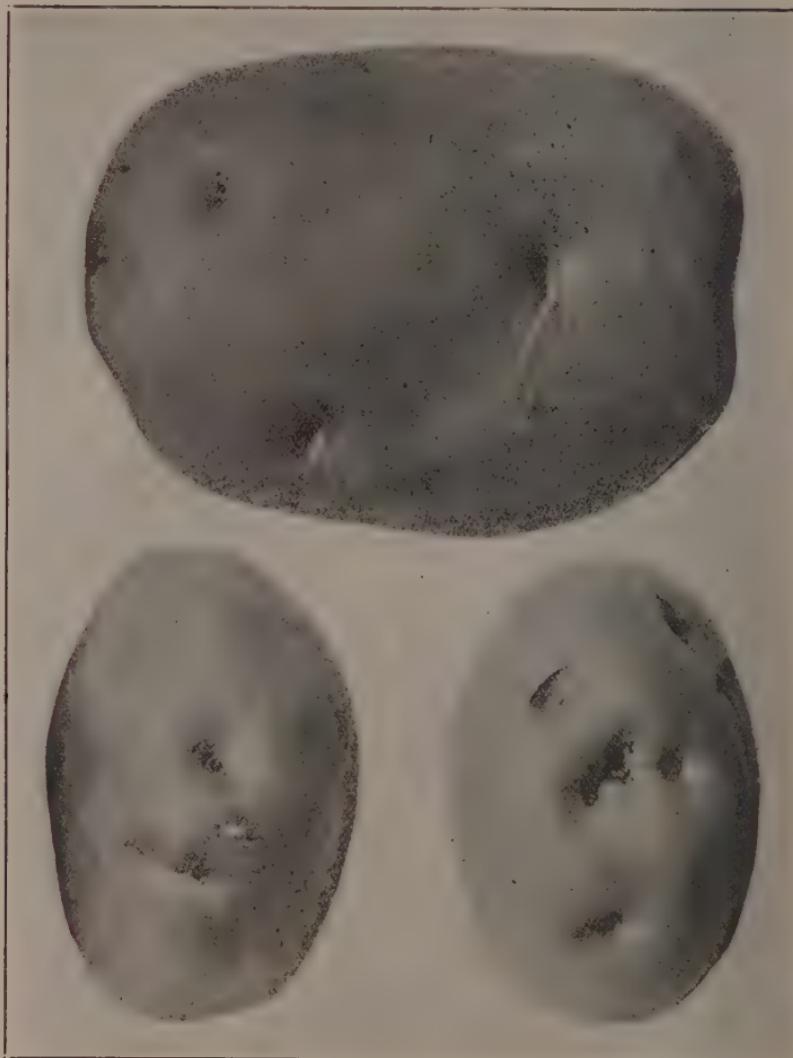
Tuber—Skin creamy white with medium number eyes and very shallow. Shape long, elliptical, and nearly cylindrical with roundish ends.

Sprouts—Similar to the Burbank Russet.

Foliage—Similar to the Burbank Russet.

Blossoms—Similar to the Burbank Russet.

Synonyms—White Chief, White Star, and Pingree which are inferior strains.



KING

King (8)

Tuber—Skin delicate pink to red, deepest color at seed end, and rather numerous medium deep eyes. Shape broad, oblong, very flattened and usually uneven surface, ends fairly square.

Sprouts—Considerably tinged from pink to dark red.

Foliage—Very large, bushy with numerous light green stems tinged with purple, medium dark leaves.

Blossoms—Usually very few or none, white.

Synonym—Maggie Murphy.

THE POSITION OF THE FLOWER STALK AS A HELP IN POTATO IDENTIFICATION

FRED A. KRANTZ, UNIVERSITY FARM
(From *The Potato Magazine*, Nov. 1919)

The advantages of standardizing the potato varieties for different sections of the country are becoming more fully realized by all potato growers and dealers. Many communities have limited themselves to the growing of only one or two varieties in large quantities, and the growers in these communities are desirous of keeping their varieties free from mixtures. A uniform product is also desired by the consumer and by the Southern growers who raise early varieties for Northern markets. Further, growers of certified seed potatoes must keep their varieties true; and thus any means of detecting



FLOWERING HABIT OF RURAL NEW-YORKER

in the Green Mountain variety the flower stalks are borne on the petiole of the leaf, at a distance from the main stalk of the plant. (See Fig. 1.) One, two, or three



FLOWERING HABIT OF GREEN MOUNTAIN POTATO

mixtures in a field is invaluable. The color of the flowers is certainly one of the best means of identification, but often-times the blossoming season is either past at the time of inspection, or the blossoms have the same color, therefore any other distinguishing characters may be of great assistance.

In making technical descriptions of plants, the writer has found the position of the flowering stalk a help in identifying potatoes in the field. For example,



FLOWERING HABIT OF EARLY OHIO

leaves may be found between flower head or cyme and main stalk. In the axil of these leaves, shoots often arise. In the Rural New-Yorker, on the contrary, the flower stalks are borne on the main stalk usually at a slight distance from the axil of the leaf (see Fig. 2). No leaves are borne between the flowering head and main stalk.

In the Early Rose and Early Ohio varieties an intermediate type exists, the flower stalks being borne in the axil formed by a leaf and the main stalk. (See Fig. 3.) Leaves may or may not occur between the flowering head and the main stalk. The Bliss Triumph and the Burbank varieties are similar to the

Green Mountain in the position of their flowering stalks. The Bliss Triumph can be separated from the Burbank and the Green Mountain by its lavender colored flowers. The Irish Cobbler is similar to the Early Ohio and Early Rose groups in its flowering habit and can be distinguished by its lavender flowers and leaf characters.

The position of the flower stalk is a distinctive character and yet it has apparently not been made use of in descriptions of potato varieties. This brief paper has been written with the hope that it may be of assistance in helping to maintain the purity of varietal stocks.



A TYPE TO PLEASE THE HOUSEWIFE

THE MINNESOTA POTATO GROWERS ASSOCIATION

A. G. TOLAAS, UNIVERSITY FARM

Minnesota ranks among the six largest potato producing states in the Union, producing annually approximately 30,000,000 bushels of potatoes, representing a money value of from \$15,000,000 to \$20,000,000. Up to 1915 there was no organization in existence in the state that represented the interests of the lowly tuber. Many thought that such an organization should be established and it was with this end in view that a potato growers' conference was called on January 7, 1915, at University Farm. The advisability of organizing a State Potato Growers' Association was discussed. It was pointed out that similar associations existed in neighboring states, and that these associations were doing good work along potato development lines, and that it was up to Minnesota to climb onto the band wagon. Before the conference was over the Minnesota Potato Growers' Association was organized and started upon its uncertain career.

Purpose of Organization

Many problems relating to the various phases of the potato industry presented themselves and it was for the purpose of assisting in the solving of these problems that the association was started. Minnesota had built up during the decade previous to the formation of the State Potato Growers' Association more or less of a reputation for the good quality of its potatoes. The slogan adopted by the association, "Better Seed, Better Potatoes, Better Prices," implied that the quality of the potatoes raised in the state was not as good as it might be, so we set out to determine what should first be done in order to live up to our slogan.

Varieties

Investigation had shown that numerous kinds of potatoes were being grown in different parts of the state under a variety

of names, so our first problem of importance was to find out which varieties were best adapted to the different soil conditions existing throughout the state. A thorough study of the situation was made with the result that the eight varieties discussed in another article in this annual were adopted as the standard varieties of potatoes for Minnesota. Since their adoption, each variety has been pushed in the locality in which the soil and other conditions are best suited to its culture. It is most gratifying to note that these varieties are fast being adopted to the exclusion of all others and that every potato-growing community is concentrating its potato development efforts on not more than four varieties; thus building up a reputation around these varieties instead of every grower raising a different kind. Unquestionably this standardization work is improving marketing conditions wherever it is being practiced.

Seed Production

Minnesota being favorably situated as a seed potato-producing state, it was imperative that something be done along the line of potato seed development, especially since adverse criticism had come from various sources, particularly from certain sections in the South, relative to the merits of our potatoes for seed purposes. Other seed potato producing states had already inaugurated systems of seed inspection and certification and it was absolutely necessary that Minnesota follow suit, but before such a system could be made possible it was necessary to carry on an educational campaign along the lines of seed selection and the control of diseases: two very important factors in the production of quality seed potatoes. Potato seed certification has been an important topic at all of our meetings during the last three years. What it means to the grower, who will do his part

WANTED—

EVERY LIVE POTATO GROWER

as a member of

THE MINNESOTA POTATO GROWERS' ASSOCIATION

ADDRESS
A. G. TOLAAS
University Farm, St. Paul



in producing high-grade seed potatoes and to the community that is favorably situated for the growing of seed stock, has been pointed out. It is just during this year that our efforts have been rewarded by the establishment of a potato seed certification system and we earnestly hope that **Minnesota Certified Seed Potatoes** will be a credit to the potato industry of the state.

Meetings

Our annual meetings are held for the purpose of discussing the various lines of potato development that are going on in the state and to outline plans for future work. During the last three years a feature of our annual meeting has been our potato show. From a very small but creditable exhibit held at University Farm in 1916 our show has become one of the largest of its kind in the United States. Each succeeding year has seen a decided improvement in the quality of the po-

tatoes displayed, indicating that a better knowledge of the type of the eight standard varieties and of the various potato diseases has been gained. In the past no particular attention was given to type, every grower having his own notion regarding the type of the variety he was growing. It is through the medium of exhibitions such as the State Potato Show that we can learn what is the most desirable type and having this knowledge, we can, by practicing careful selection, more quickly attain a uniformity of our product.

Potato machinery has also been a feature of our show, and we hope at our future shows to bring together as much as we can of the latest types of machinery used in growing and marketing the crop.

In 1917 when food conservation became so important and we were urged to use potatoes as one of the substitutes for wheat flour, interesting educational exhibits were made showing the value of

SOME Potatoes

30,000,000 Bushels
Minnesota's Annual Yield

STATE AMONG
SIX GREATEST
PRODUCERS
IN UNION

When will it lead them all?

the potato as food and the numerous ways in which it could be prepared. The possibilities of the potato as food for human beings are many and these exhibits and demonstrations were a means by which some of these possibilities have been brought out. Greater emphasis will be given to this feature at future shows.

As time goes on other features will be added and we soon hope to stage an exhibit in which everything connected in any way with the growing of this impor-

tant crop will be shown. A convention and show of this kind is an educational institution in itself.

The Potato Growers' Association considers itself an institution whose purpose it is to help the growers solve their problems in doing just such things as have been briefly discussed in this article and we want every live potato grower to become a member and in this way help the good work along.



JOSEPH WALSH, LAKE COUNTY, STATE CHAMPION, 1917

POTATO SEED CERTIFICATION IN MINNESOTA IN 1919

A. G. TOLAAS, UNIVERSITY FARM

In accordance with the new Potato Seed Inspection and Certification Law, enacted at our last legislative session, a board known as the "Minnesota Board for Seed Potato Inspection and Certification" was created for the purpose of handling this new feature of potato development work.

The rules and regulations for carrying on the work were adopted by the board at their first meeting and are printed elsewhere in this Annual. On account of the fact that the organization was not effected until late in June, August first was set as the last date for receiving applications. This caused considerable difficulty in starting the actual work of inspection which commenced the second week in July. In the future applications will not be accepted after July first.

The purpose of the work is to provide means for official inspection and certification of potatoes. To be eligible for certification, potatoes must conform to prescribed standards of purity, correctness of type, vigor and freedom from disease. Some growers have had the impression that only certified potatoes could be offered for sale as seed. This is an entirely erroneous impression. Any grower may apply for inspection but is under no obligation to do so. Applications for inspection are made on blanks as shown in Figure 1. Fees are paid according to the scale of fees found under rules and regulations.

Inspection of Fields

Two field inspections are made, one at flowering time and the other about a month later. The purpose of the first inspection is to determine varietal purity, vigor of the plants and the amount of disease. Actual percentages are determined by the inspector by counting at random not less than 400 hills in different parts of the field. The hills are counted consecutively in 100-hill blocks,

the total number counted depending on the size of the field. If a field passes the first inspection but contains a small percentage of varietal mixtures and diseases as outlined under rules and regulations, the second field inspection is made in a similar manner. The purpose of this inspection is to detect diseases which may have appeared since the first inspection and also to see whether the owner of the field has removed all undesirable plants according to instructions previously left by the inspector. A final inspection of the tubers is made to determine type and freedom from certain tuber diseases. Records are kept on forms shown in Figure 2. Every grower whose potatoes pass all of the inspections is required to sign an agreement card (Figure 3) and to pay a final fee before he is issued his certificate (Figure 4). Tags to be used on the containers in marketing the potatoes are issued at one cent per cwt. of potatoes. Two kinds of certification tags are issued; complete and limited. The complete certificate is issued for potatoes which conform in every respect to the prescribed standards. The limited certificate is issued for potatoes which are equal to the above except that they contain more than 5% and less than 20% of mild Mosaic. Figures 5 and 6 show the tags used.

The board received 544 applications from 33 counties, covering a total of 2,910 acres. About one-half of the fields inspected were rejected. Most of the rejections were on account of varietal mixtures, poor stand, Blackleg, Rhizoctonia and lack of constitutional vigor. Many Bliss Triumph fields were rejected on account of the Mosaic disease which is particularly serious on this variety. As a matter of fact but very few complete certificates were granted to growers of this variety. However, we feel that all of the Triumph seed stock which was inspected and given a limited certificate

Form 5

MINNESOTA BOARD FOR SEED POTATO INSPECTION AND CERTIFICATION

APPLICATION FOR INSPECTION

I hereby apply for inspection of 10 acres of Early Ohio potatoes, and submit herewith to the best of my knowledge, information concerning the seed from which said crop is to be grown.

John Doe Moosehead Clay
 Name Post Office Address County

History of seed Obtained from seed house 1915. Have been growing seed plot since then and hill selecting every year.
 Performance of seed 1915 very good; 1916-17 averaged about 200 bu. per acre; 1918 yield was about 225 bu.

Source of seed Seed house 1915. (Do not know history further back than this).

Approximate yield of field Yielded 225 bu. in 1918.

from which seed was obtained

Percentage of disease in the field Very little disease present.

from which seed was obtained Some blackleg

Growing conditions in the field Excellent. Very even stand. A very

from which seed was obtained strong vigorous growth was produced.

Crop history of field intended 1917 oats seeded to clover; 1918 clover

for certification

Approximate date of planting May 20, 1919

Initial fee \$.50

Note: Include initial fee when application blank is returned. Make all checks payable to the State Treasurer.

FIG. 1. APPLICATION FOR INSPECTION.

MINNESOTA BOARD FOR SEED POTATO INSPECTION AND CERTIFICATION

RECORD OF INSPECTION

Name of Applicant John Doe
 Post Office Address Moorhead County Clay
 Variety Early Ohio Acreage 10

FIELD INSPECTION

General Cultural Conditions Date 7/20/19 8/25/19
 Stand 92% Constitutional vigor Very Good Freedom from disease Less than 2%
 Varietal Purity 98 1/2%

Disease Conditions	First Inspection	Second Inspection
Leaf roll		
Curly dwarf		
Mosaic		
Black leg	1% at 1st. insp.	0
Fusarium	1%	0
Late blight		
Early blight		
Insect injury	Very little Potato Beetle injury.	
Frost injury		
Other disease conditions	Trace of Rhizoctonia.	

OFFICIAL RECORD

Instructions to growers at time of First Inspection Rogue varietal mixture, and diseased plants.

Field rejected on account of

First Inspection	Second Inspection	
Passed	Passed	
		John Jones Inspector.

FIG. 2. RECORD OF INSPECTION

is far superior to the ordinary run of Triumphs.

A special effort must be made to grow Mosaic-free Triumphs since in the eyes of our Southern friends who plant Minnesota seed stock it is the worst disease with which they have to contend. The Minnesota Experiment Station together with other experiment stations is co-operating with the United States Department of Agriculture in testing different strains of Triumph potatoes with a view toward

obtaining a strain or strains free from Mosaic which can be distributed to growers as good foundation seed stock.

A considerable number of growers sold their potatoes before the final inspection was made, on account of the high prices this fall, and a number of men withdrew. In a number of cases a part of a field was withdrawn and the remainder certified.

Following is a table summarizing the result of this year's work:

No. Applications	No. Acres Applied for	No. Rejected 1st Inspection		No. Rejected 2nd Inspection		No. Rejected 3rd Inspection		No. Withdrawn		No. of Acres Certified
		Appl.	Acres	Appl.	Acres	Appl.	Acres	Appl.	Acres	
Total, 544	2909	113	494	104	491	30	262	55	377	1285

TUBER INSPECTION					
Date <u>10/15/19</u>					
Varietal Purity	<u>100%</u>				
Trueness to Type					
Shape <u>75%</u>	Color <u>Good</u>	Size <u>Medium</u>	Markings	Characteristic.	
Disease Conditions					
Fusarium					
Powdery scab					
Common scab <u>5%</u>					
Rhizoctonia <u>3%</u>					
Late blight rot					
Storage rots					
Other disease conditions					
Yield					
Yield per acre <u>150 bu.</u>					
Total yield <u>1500 bu.</u>					
No. of bushels to be certified	<u>1000 bu.</u>				
Maturity	<u>Good</u>				
OFFICIAL RECORD					
Instructions to grower	<u>Grade carefully, sort out any knobby tubers.</u>				
Stock rejected on account of					
Date approved for certificate	<u>10/15/19</u>				
<u>John Jones</u> Inspector.					

FIG. 2½. THE REVERSE SIDE OF RECORD SHOWN IN FIG. 2.

Form 2

MINNESOTA BOARD FOR SEED POTATO INSPECTION AND CERTIFICATION

GROWERS' AGREEMENT

Date 10/31/19

In consideration of the inspection service and certificate granted me I agree to fulfill all conditions required by the Minnesota Board for Seed Potato Inspection and Certification in the inspection of my potato crop and in the granting of said certificate.

Signed John Doe
 Post Office Address Moorhead
 County Clay.

FIG. 3. GROWERS AGREEMENT.

Form 3

MINNESOTA BOARD FOR SEED POTATO INSPECTION AND CERTIFICATION

CERTIFICATE OF POTATO SEED INSPECTION

This certifies that the potato field and seed stock of John Doe _____ Name_____Moorehead
Post Office _____ Clay
County _____ Minnesota as per application No. 3 has

been inspected by a duly authorized agent of the Minnesota Board for Seed Potato Inspection and Certification, and that said stock meets the prescribed standards relative to freedom from disease and varietal purity.

The grower of the seed stock certified to above has complied with all of the rules and regulations prescribed by the Minnesota Board for Seed Potato Inspection and Certification and has signed an agreement that he will carry out the full intent and purpose of this certificate.

REQUIREMENTS FOR ELIGIBILITY FOR CERTIFICATION

Freedom from varietal mixtures conformity to the accepted type of the variety (allowance is made for minor variations due to local conditions of soil and climate) to such desirable grades as can be obtained by sorting. (1½ inch screen required for early varieties; 1¼ inch screen required for late varieties.)

Freedom from serious infection of diseases, except in case of late blight and black wart. Either or both of these diseases will disqualify for certification.

The holder of a certificate is responsible for all undesirable conditions which may occur after the final inspection has been made.

R. W. Thatcher
Secretary of the Board.A. H. Tolosa
Chief Inspector.Following is a record of the inspections of EARLY OHIO _____ potatoes grown by_____John Doe
Name _____ Moorehead
Post Office _____ Clay
County _____

Minnesota, and pertains only to those potatoes covered by this certificate.

Variety EARLY OHIO Acreage 10 Amount 1000 bu.

Field Inspections:

Varietal purity 98½%Freedom from disease ½ Black leg, ½ Fusarium, (rogued).Trace Rhizoctonia.

Tuber Inspection:

Varietal purity 100%Freedom from disease 5% Common scab, 3% Rhizoctonia.Yield per acre 150 bu. Quality Good Type GoodRemarks: THIS CERTIFICATE COVERS THE CROP GROWN IN 1919.

FIG. 4. CERTIFICATE OF INSPECTION.

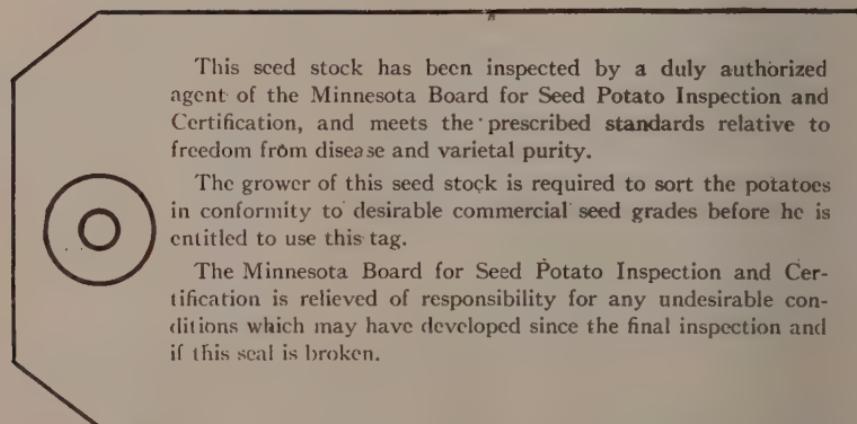


FIG. 5. SHOWING BOTH SIDES OF THE TAG FURNISHED TO GROWERS OF SEED POTATOES WHICH HAVE PASSED THE INSPECTION FOR VARIETAL PURITY AND FREEDOM FROM DISEASE.

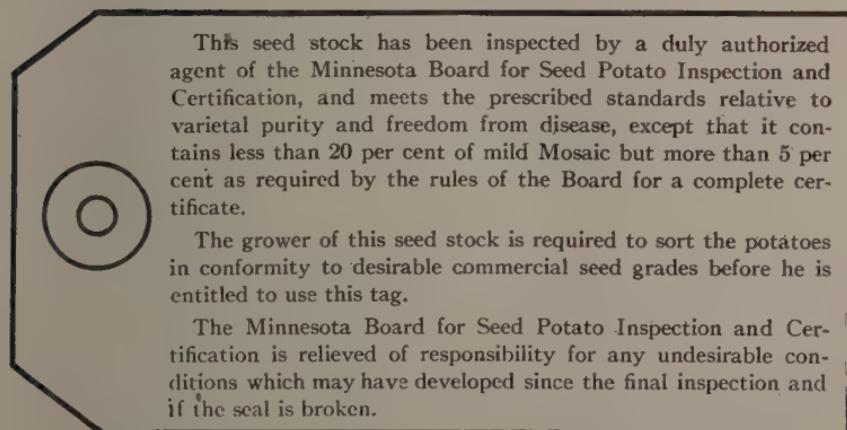


FIG. 6. SHOWING BOTH SIDES OF TAG FURNISHED GROWERS OF SEED POTATOES WHICH HAVE PASSED THE INSPECTION WITH CERTAIN EXCEPTIONS.

THE SEED POTATO INSPECTION AND CERTIFICATION LAW

AN ACT creating a board for seed potato inspection and certification, providing penalties for the violation of such provisions.

BE it enacted by the Legislature of the State of Minnesota:

Section 1. Inspection of Seed Potatoes Authorized.—The inspection and certification of potatoes for seed purposes by or under the direction of the board hereinafter created and under the conditions and limitations herein specified, is hereby authorized.

Sec. 2. Inspection Board and Membership.—There is hereby created a board for seed potato inspection and certification. It shall consist of five members, two of whom, the dean of the College of Agriculture of the State of Minnesota and the president of the State Potato Growers' Association, shall be ex-officio members. The three remaining members shall be appointed by the governor for the term of three years each; provided, that of those first appointed one shall hold his office for one year, one for two years, and one for three years.

The members of said board shall be residents of this state and thoroughly acquainted with the business of potato-growing, either by actual experience or education and interested in the propagation of pure seed.

Sec. 3. To Be Paid Only Actual Expenses and Duties.—The members of said board shall serve without pay, but their actual expenses shall be paid from the fund hereinafter provided. Said board shall organize within thirty days after its appointment and shall adopt such rules and regulations with reference to the conduct of its business and the inspection and certification of seed potatoes as it shall deem advisable, except that no certification or purity or quality shall be made except upon an inspection both of the crop while it is growing and after it is harvested, and no rules shall be promul-

gated which will authorize the appointment of inspectors who are not familiar with the business of raising potatoes. Said board shall appoint such inspectors, officers and employers as it may deem necessary; fix the amount of salary or the fees to be received by each, and the amount of fees to be paid by potato growers desiring inspection and certification. Said board shall also provide the various forms necessary for use by growers in applying for inspection and by inspectors in their work of inspection and certification and shall specify the methods to be used by officers and inspectors and shall direct that no certificates shall be issued except upon stocks duly inspected and which are in the hands, or under the control of the original grower.

Said board shall also provide permanent records of its own organization, rules and acts and a record of the work of its inspectors and officers.

Sec. 4. Each Member to Give Bond.—Before entering on the duties of his office each member of said board shall give bond to the State of Minnesota with sureties to be approved by the governor in the sum of \$5,000, conditioned for the faithful discharge of the duties of his office. The cost of such bonds shall be paid from the funds hereinafter provided. Every inspector or deputy and every officer appointed by said board shall give bond to the state in such sum as said board shall direct with sureties to be approved by the board, conditioned for the faithful discharge of the duties of their respective offices.

Sec. 5. Fees to be Fixed by Board and Salaries, Etc., to be Paid From Fund.—The fees for inspection shall be fixed by the board and shall be paid or secured at the time of inspection. All moneys so collected together with any fines and penalties for the violation of any of the provisions of this act, shall be paid into the state treasury and known

as the potato inspection and certification fund, and paid out only on order of the board and auditor's warrant. Any interest received from deposit of said monies shall be credited to such fund.

All expenses of the board and all salaries and fees of inspectors, officers and employes shall be paid out of said fund. There shall be paid into said fund from time to time such sums as may be provided by the legislature for the purpose of carrying out the provisions of this act.

Sec. 6. Application for Inspection and Certification.—Any potato grower may make application to said board for inspection and certification of his crop growing or to be grown in this state, giving description of his land and such other information as said board shall require and pay or secure the amount of the fee required for such purpose to said board, and thereupon this crop shall be listed for inspection by said board and inspected and certified by it under the rules and regulations adopted by it for the government.

Sec. 7. False Certificate Declared a Gross Misdemeanor. Any inspector, deputy or officer who shall negligently or carelessly inspect or give any false certificate or inspection or accept money or other consideration directly or indirectly for any negligence or improper performance of duty, and any person who shall improperly influence or attempt to influence any such inspector, deputy or officer in the performance of his official duty, and any person who shall change in any manner the certificate attached to and intended for the containers of potatoes which have been inspected to containers of potatoes which have not been inspected shall be guilty of a gross misdemeanor.

Sec. 8. Certain Terms Prohibited.—Any person not connected with the state inspection and certification department is hereby prohibited from using the term "Inspector" or "Deputy Inspector" or any other words or device calculated or intended to indicate that the certificate made by him is issued under the au-

thority of any officer or person connected with such department and is hereby prohibited from otherwise deceiving or misleading the public as to the inspection or any certification of inspection of seed potatoes.

Any person found guilty of violating any provisions of this section shall, upon conviction, be punished as for a gross misdemeanor.

Sec. 9. This act shall take effect and be in force from and after its passage.

Approved March 31, 1919.
Rules for Potato Seed Inspection and Certification

I. Seed Potato Plots: It is strongly urged upon all who expect to grow certified potatoes to maintain a permanent seed plot and to follow all of the precautions which are given in Minnesota Special Bulletin No. 35 and in Station Bulletin No. 158.

II. It is strongly urged that local potato growers' associations, affiliated with the state organization, be formed in those communities where certification will probably be asked for. These local associations should grow preferably one, or at most very few standard varieties best suited to the locality. The officers of the associations should take an active part in co-operating with the inspectors.

III. Application for Inspection.

1. Time limit:

All applications for inspection must be made to the Chief Inspector by June 15th of the year in which inspection is desired (July 1st, for 1919) on blanks which will be supplied on request.

2. The application should be accompanied by the following information:

- a. Varieties grown.
- b. Acreage.
- c. History of the seed.
- d. Performance of the seed.
- e. Source of seed.
- f. Approximate yield of field from which seed was obtained.
- g. Per cent of diseases in the field from which seed was obtained.
- h. Growing conditions in the field

from which the seed was obtained.

- i. Crop history of field intended for certification.
- j. Approximate date of planting.

3. Fees:

The application for certification must be accompanied by an initial fee of fifty cents per acre for the number of acres for which application for certification is made.

Inspections

I. Object: The following information must be available before seed can be certified.

1. Stand.
2. General constitutional vigor.
3. Freedom from diseases.
4. Varietal purity.
5. Trueness to type.

II. Number: Three inspections will be made at the following times:

1. Flowering time.
2. When the vines are ripe, but before they have dried or died.
3. Digging time, or when the potatoes are in storage.

Requirements for Eligibility for Certification

I. Varieties: Only the varieties now adopted or which may be adopted in the future by the Minnesota Potato Growers' Association as standard varieties for Minnesota will be eligible for certification. The initial list is as follows:

1. Early Ohio.
2. Bliss Triumph.
3. Irish Cobbler.
4. Rural New Yorker.
5. Green Mountain.
6. Burbank.
7. Burbank Russet.
8. King.

Other varieties such as:

Carman No. 1.
Carman No. 3.
Sir Walter Raleigh, etc.

which belong to one of the above groups will be certified under the name of the group to which the variety belongs.

II. Varietal Purity: Fields contain-

ing any varietal mixture at the time of the first inspection will not be eligible for certification unless all foreign varieties are removed by the grower under the direction of an inspector. A field containing more than 2 per cent varietal mixture will not be eligible for certification under any circumstances.

III. Constitutional Vigor: Potatoes will not be eligible for certification if the field contains more than 5 per cent of weak plants.

IV. Type: The tubers must conform to the accepted type for the variety in shape, color, size, and characteristic markings. (Allowance will be made for minor variations due to local conditions of soil and climate.)

V. Size: The size must be fairly uniform. Ideal seed potatoes should weigh from 2 to 8 ounces. Potatoes will not be certified if more than 5 per cent of the tubers weigh less than 2 ounces or over 10 ounces in the case of early varieties, and over 12 ounces in the case of late varieties. The early varieties (1, 2, 3) should be graded over a $1\frac{5}{8}$ -inch screen and late varieties over a $1\frac{3}{4}$ -inch screen.

VI. Freedom from Disease: The following percentages of diseases will disqualify seed stock for certification:

A. Vine Diseases:

1. Total of 5% of the following:
 - a) Leaf roll.
 - b) Curly dwarf.
 - c) Mosaic.
2. More than 1% of hills affected with Blackleg at the time of the first inspection.
3. More than 2% of Fusarium wilt at the time of first inspection.
4. A field containing more than a total of 5% of all the above diseases combined will not be considered for certification.
5. In order that fields may become eligible for final certification all diseased plants must be removed before the second inspection.
6. Late Blight infection disqualifies potatoes for certification.

B. Tuber Diseases:

7. More than 5% of characteristic brown ring discoloration of Fusarium wilt.
8. More than 5% of powdery scab.
9. More than 10% of common scab.
10. More than 10% of Rhizoctonia—moderate infection.
11. Presence of late blight rot shall disqualify.
12. All bin rots shall be removed.
13. A total of more than 10% of all tuber diseases will disqualify.
14. Presence of Black Wart shall disqualify.

Machinery of Certification

I. Form of Certificates: A certificate in duplicate will be issued the grower if his potatoes meet the required standards. When the potatoes are shipped certification tags must be attached to the container under the supervision of an inspector.

II. Certifying Seed in Containers: Seed potatoes must be sold only in containers which can be sealed by certification tags. The tags must be attached by the Chief Inspector or a person properly deputized by him. The tags constitute a seal the breaking of which relieves the Inspection service of responsibility for the potatoes in the container. When potatoes are consigned to associations of potato growers, carload lots in bulk may be cer-

tified. The tags will then be attached to the seal of the car and the same rules apply as apply to smaller containers.

III. Form of Records: Accurate records relative to inspection and certification will be kept in the office of the Chief Inspector.

IV. Penalties for Violation: Provided for by law.

V. Follow-up Campaign: The Chief Inspector shall obtain the destination of certified seed and either by correspondence or by personal visit, shall determine the degree of satisfaction which the certified seed has given and obtain information on the actual results from such seed as compared with ordinary seed.

Fees

I. Initial Fee: An initial fee of fifty cents per acre must accompany all applications for inspection.

II. Final Fees: (a) Fees must be paid according to the following sliding scale before certificates will finally be issued:

\$1.00 per acre for fields from 1-10 acres, inclusive.

\$0.75 per acre for fields from 11-20 acres, inclusive.

\$0.50 per acre for fields of 21 acres or over.

(b) One cent per cwt. shall be paid when the tags are attached to the containers.

POTATO IMPROVEMENT THROUGH SEED PLOTS—KITTSON COUNTY

W. V. LONGLEY, HALLOCK

More uniform, better type potatoes, much freer from disease are the results accomplished through selection by means of seed plots in Kittson County. Some increase in yield has also been brought about; the average of twelve seed plots in the county in 1918 showing an increase per acre of 12 bushels but with good seed to start with and proper seed treatment the increase in yield has been slight, if any. Comparing, for 1918, the plots that were treated with corrosive sublimate with the fields that were not so treated we have an increase in yield of 22 bushels in favor of the plots.

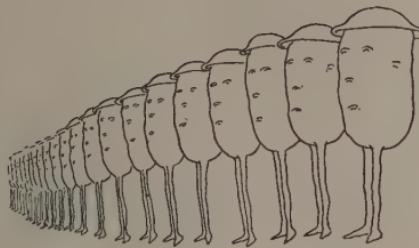
Farmers Use Seed Plots

Charles Youngren, Northcote, was the first farmer in the county to start seed selection. Mr. Youngren started it because of loss due to disease; and did so on the advice of C. E. Brown at a Farmers' Institute meeting. As a result a seed plot of about one acre was started on this farm five years ago and no man in the county today has potatoes which are so uniform in size and shape. Disease has been practically eliminated. B. E. Sundberg, Hallock, and Louis Swanson, Kennedy, started a year later. In 1918 the Farm Bureau started potato improvement as one of its projects and eleven growers carried on seed plots. This number was increased in 1919 to seventeen. Those carrying on the work in the county in 1918 were Charles Youngren, B. E. Sundberg, H. M. Pearson, Louis Swanson, Erick Fossell, Henry Spangrud, Dave Dagen, A. W. Anderson, A. H. Halvorson, John Steen and Olander Benson. A. W. Anderson and Olander Benson dropped the work in 1919 and Nordine Brothers, Alfred Carlson, C. C. Dawson, Hallgren Brothers, Oscar Danielson, Theo. Silnes, Issak T. Folland and Adolph Hoglin were added.

Blackleg

Blackleg has been causing more trouble to Early Ohio growers in the county than any other disease. Careful work has been necessary to eliminate it. In one instance in 1918 the treated plot only showed a trace of Blackleg while the untreated field showed 20%; resulting in a yield of 175 bushels on the treated plot and 113 bushels on the field. The field count on the plots of all co-operators for Blackleg for 1918 showed 11-12 of one per cent as against 4½% for the fields. Two projects in which seed for both plot and field were treated with corrosive sublimate, seed treatment having been practiced for two years, showed only a trace of Blackleg in both plot and field. Two other projects where seed for the field as well as for plots was treated showed 1-10 of one per cent for plot as against 1-7 of one per cent for field and 1-10 of one per cent against two per cent. Seven other projects in which the plot was treated with corrosive sublimate and the fields were untreated showed 5-7 of one per cent average diseased plants for the plot and five and one-half per cent for the fields. One man used formaldehyde to treat with but it did not prove as effective as corrosive sublimate. Plots averaged one-fourth of one per cent in 1919 as against one and three-fourths per cent for the fields. The fields were, however, in most all cases treated as well as the plots. B. E. Sundberg's field showed only a trace of Blackleg in 1918, still the same seed planted by E. J. Finney, untreated, showed up five per cent of diseased plants. The effectiveness of selection and treating in handling of Blackleg is thus shown. Wilt is present only to a limited extent in the county. Scab and Rhizoctonia are prevalent but are causing little loss to those who are selecting and treating and then planting on ground which has not

*More Potatoes
Better Potatoes
More uniform Potatoes
Disease-free Potatoes*



These are the results of
Potato Seed Selection
By means of SEED PLOTS
In Kittson County

Try it in Your County!!!

grown potatoes for several years. Several have greatly reduced the amount in their potatoes in the two years' work by selection and treatment.

Certified Seed

Seed plot work is necessary to the production of state certified seed potatoes and it is those who had seed plots last year who are in a position to have their stock certified this year. Nine farmers have certified seed this year in the county. Four of these nine had seed which would have passed certification a year ago due to having potatoes that had been well selected. These farmers were Charles Youngren, B. E. Sundberg, Louis Swanson and Erik Fossell, while a fifth, Charles Turn, a neighbor of Mr. Fossell, obtained his seed from him. He bought this seed last spring because he found last fall at digging time that he had a large percentage of rots due to Blackleg in his field while Mr. Fossell had practically none. A. H. Halvorson, H. M. Pearson, Henry Spangrud and Nordine Brothers started selection last year. Attention has been attracted to these men in the county on account of the quality of stock being produced with the result that others are

taking up the work of seed selection or are buying potatoes from these men to start with.

More Corrosive Sublimate Used

The records show that 105 pounds of corrosive sublimate were sold in the county in 1919 as against 30 pounds in 1918. This shows the great increase in treating of seed potatoes in the county. The greater use of corrosive sublimate can be said to be a result of the campaign for selecting and treating and has gone along with greater care in selection of seed and in proper disease control methods.

Purity of seed is another important factor to all growers who are growing for the seed trade; and through selection growers are eliminating other varieties. Trueness to type of the potatoes of those who have been selecting for several years has been brought about by the most careful work. Seed selection with seed treatment is aiding greatly in the production of first class seed of Early Ohios in the county and further through the campaign being carried on is increasing not only the quality of the stock of the county but is increasing the yields through better methods and through disease control.



A TYPICAL RED RIVER VALLEY FIELD OF EARLY OHIOS.

THE POTATO SEED PLOT

A. G. TOLAAS, UNIVERSITY FARM, ST. PAUL

Minnesota is one of the states most favorably situated for the production of seed potatoes, and it is looked toward as a source of first-class seed potatoes by growers in the southern states. Its ideal climatic conditions, especially in the northern half, together with a variety of soils adapted to the growing of potatoes make for successful potato growing, provided that these factors are supplemented by the right kind of growers; men who know the potato growing business from A to Z.

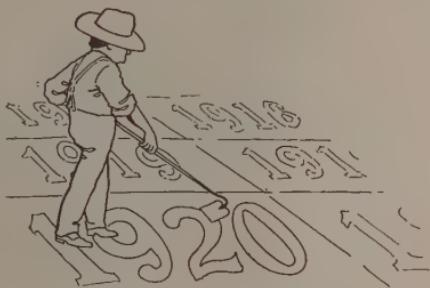
Seed Plots

Recognizing the fact that a considerable amount of potato development work was necessary in the state, a great deal of potato seed plot demonstration work has been carried on with a view of getting the live growers interested in producing real quality potatoes by paying more attention to adaptable varieties, type, and to the control of diseases. Our aim of course, has been, primarily, to interest every grower in producing the best potatoes possible and to prepare those growers located in the most favorable seed potato producing sections for the growing of certified seed potatoes.

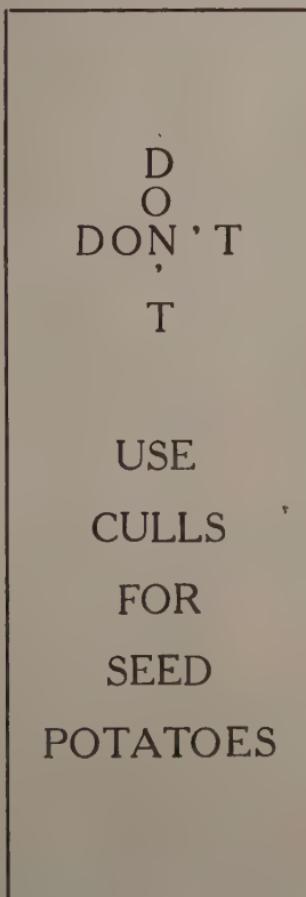
In the past the majority of growers have paid but little attention to proper seed selection and to treatment against diseases. The common practice has been to dig and either sell directly from the field or to put the potatoes into the storage cellar and then sell everything until enough potatoes regardless of size, type or condition, remained in the back end of the cellar to furnish seed for next year's planting. Sometimes the entire crop has been graded and the graded stock sold, leaving the culls to be used as seed stock. Continued practice of this kind soon leads to difficulties.

Maintain a Seed Plot

By growing a seed plot every year a grower can improve or at least maintain



GROW A SEED PLAT EVERY YEAR



the quality of his stock. Through the seed plot demonstration work carried on by the county agricultural agents in the potato growing counties about 5,000 live potato growers had seed plots in 1919.

Every potato grower who intends to grow certified seed is especially urged to maintain a seed plot every year, since the potato seed certification requirements are rigid and the seed plot is a means whereby excellent seed stock can be produced for the field intended for certification and will lessen the chances of the field being condemned when inspected.

Important Points

Mr. Potato Grower! You can help raise the standard of Minnesota potatoes by practicing the following recommendations: Grow the varieties of potatoes recommended for the various soils and market requirements of Minnesota. Grow only one or two varieties in any one community. Establish and maintain a potato seed plot. Select a piece of ground in which potatoes have not been grown for several years. Carefully select the seed to be used in this plot with regard to type and freedom from disease.

By careful selection, control of diseases, and good cultural practices, and by growing varieties best suited to local conditions, an increase in yield of from twenty-five to fifty per cent, and a great improvement in quality may reasonably be expected.

Keep up the practice of growing a seed plot every year. Select the seed potatoes for next year's seed plot at digging time, from good yielding hills producing a uniform type of tubers. This is best done by digging the hills by hand before the entire seed plot is dug. The seed plot tubers so selected should be put away in barrels or crates and stored in a cool well ventilated place so that the potatoes will be in the best possible condition the following spring.

Seed for Field Planting

The remainder of the potatoes in the

seed plot should be dug, carefully sorted and stored separately from the field-grown stock as seed for the general field the succeeding year, all undesirable tubers first being discarded.

Do not plant any tubers that show a tendency to run out. It is a good policy to discard all such stock and to obtain seed from some grower who has a good, vigorous producing strain of the desired variety.

All selected tubers should be carefully treated in a solution of corrosive sublimate as described in the chapter on potato diseases.

Inspect the seed plot carefully, twice during the growing season in order to remove any weak, undesirable plants.

Spray the seed plot thoroughly with Paris green or some other good insecticide. To prevent possible loss by blights spray with Bordeaux mixture.

A Summary of some of the Results of Seed Plot Demonstrations carried on in Clay County in 1918

Plot	Yield on Field per Acre	Yield on Plot per Acre	Increase
1	75 bu.	100 bu.	25 bu.
2	75 bu.	165.4 bu.	90.4 bu.
3	135 bu.	141 bu.	6 bu.
4	115 bu.	175 bu.	60 bu.
5	90 bu.	105 bu.	15 bu.
6	105 bu.	134.8 bu.	29.8 bu.
7	70 bu.	110.5 bu.	40.5 bu.
Average-...	95 bu.	133.1 bu.	38.1 bu.

The seed potatoes used on the seed plot were carefully selected as to type, and the stem ends cut off to eliminate the possibility of planting wilt infected potatoes. See article on potato diseases in this Annual. The potatoes were then treated with a solution of corrosive sublimate consisting of 4 ounces of corrosive sublimate to 30 gallons of water for 1½ to 2 hours against such diseases as common scab, Rhizoctonia (black scurf) and Blackleg.

Roguing

No careful selection was made in the case of the seed potatoes planted on the general field and no treatment was given. The plots were inspected during the growing season for the purpose of roguing (removing) all diseased plants and to obtain a comparison at that time of the vine diseases (wilt, Blackleg and Rhizoctonia) on the plots and fields. In all of

the above plots the vine diseases were reduced to less than $\frac{1}{4}$ of 1% while some of the adjoining fields planted with the same seed stock, without selection or seed treatment, contained as high as 20% of the above diseases. The tubers from the seed plots were in all cases more uniform and free from scab and black scurf than the potatoes from the field.

GOOD SEED POTATOES AND HOW TO OBTAIN THEM

C. A. JOHNSON, DALBO, MINNESOTA

The writer will give what he believes to be the best method of obtaining good seed potatoes. The following factors may be responsible for a low yield; poor soil, unfavorable weather conditions, poor care and poor seed potatoes. The last two factors in my belief can be controlled by the grower. A large number of growers will often plant cull potatoes which can not be marketed, while others probably leave enough in their cellars for seed after they have sold most of the crop. Both of these methods are poor as compared with the selection of seed potatoes at digging time when the smooth type tubers from good yielding hills can be selected. However, I would go still further and practice what is known as the tuber unit method.

Tuber Unit Method

I will here describe in a brief way what I have done with this method, which has paid me manifold, as I can very easily see by the increased yield, and improvement in my potatoes which are better now than they were a number of years ago. Nine years ago when I was cutting my seed potatoes I laid aside four of the best potatoes I could find and called them Number 1, Number 2, Number 3, and Number 4. Each tuber was cut into eight seed pieces and each lot was planted in the regular potato field but separated by stakes. All of the seed pieces grew but Number 1 never had the growth that

Numbers 2, 3 and 4 had. This proved to me that there was a difference in the seed. These units were cultivated and sprayed when the rest of the field was taken care of. In the fall each lot was dug separately. I discarded Number 1 as it showed up very poorly. At this time Number 2 was the best as to shape and yield. However, I also kept Numbers 3 and 4. The yield from each original tuber was kept separately in boxes over winter in the cellar. The following spring each lot was cut into seed pieces containing from one to more eyes. All told I had 142 seed pieces which were planted in my regular potato field but each lot was kept separate and marked off with stakes. In the fall each lot was dug separately and Number 2 again proved best as to shape and yield, producing 5 bushels of very good seed potatoes. Numbers 3 and 4 each produced $4\frac{1}{2}$ bushels. Lots 3 and 4 were then discarded and I kept lot 2 for my foundation stock which had all come from a single potato two years before.

Hill Selection

From that time on I have practiced hill selections generally going into the field ahead of the digger with a fork and selecting my seed potatoes. The single potato that I started out with nine years ago was of the Burbank variety and the strain developed from this single tuber is yielding as well now as it did then. I

TUBER UNIT METHOD

Used to get Foundation Stock for
SEED

have found that the Burbank variety has proved to be the best potato on my soil which is a black rather heavy clay loam.

I am also raising Early Ohio, Irish Cobbler and Bliss Triumph potatoes and have tried the Green Mountain and King varieties. These last two varieties yield more than the others but are not to be depended upon as they grow too large in a favorable year and are hard to sell. I also grow the Burbank Russet and will say that in my opinion this variety is the finest and best potato known.

Disease and Bug Control

I have always treated my seed before planting with either corrosive sublimate or formaldehyde and one is just as good

as the other. Five years ago I began to use arsenate of lead as a spray for bugs and I have found it much better than Paris Green. It also is cheaper.

It has been the custom in this community to plant potatoes in check rows 3 feet by 3 feet, but two years ago I bought a potato planter and have found it so satisfactory that I would never think of going back to the check row system any more. I plant my potatoes 18 inches by 3 feet and I find that cultivating once before the plants are up by following the mark made by the planter is worth more than three later cultivations. I follow this first cultivation with the harrow once or twice and the weeds are very easily kept under control by this practice.

POTATO ACTIVITIES OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

BY WM. STUART

It may be of interest to those who are not familiar with the organization of the Federal Department of Agriculture to know that it is divided into various Bureaus and offices, and furthermore, that several of them are engaged in potato investigations of one sort or other. In order therefore, to discuss the potato activities of the Department as a whole, the party undertaking it must be more or less fully informed as to what each Bureau or Office is doing.

The Weather Bureau has given considerable attention to the relation of temperature and moisture to the development of the crop, particularly during the whole period of tuber formation. As a result of this study they have been able to publish some very interesting information relative to the critical period in the growth of the plant and the effect of unfavorable climatic conditions during such period. The Bureau of Soils has made certain studies dealing with the question of the proper supply of plant food to produce a maximum crop and of soil types. The Bureau of Chemistry is concerned in investigations dealing with the utilization of the crop for other purposes than that of table consumption in the fresh state. These investigations deal with the manufacture of dehydrated products intended for table use, such as dried, sliced, cubed, or riced potatoes, potato flour, etc.; and the manufacture of starch, and dextrin.

Marketing

The Bureau of Markets is engaged with the various problems connected with the successful harvesting, storing, handling, and marketing of the crop. Their market news service has proved of inestimable value to both the producer and the dealer in that it furnishes the grower with reliable information concerning the selling price

of potatoes in the leading markets; and in the case of the dealer, it furnishes him with a more comprehensive knowledge of the extent and movement of the crop to markets to which he naturally ships. Some very valuable work has been accomplished by those engaged in the problem of transportation, the proper loading of the car in order to insure good air circulation, proper insulation against frost, and least loss from injury sustained through broken packages or shifting of load in transit,

The Office of Farm Management has given considerable study to the importance of the potato as a farm crop, suitable rotation crops, and period of rotation, potato machinery, cost of production, etc.

Bureau of Plant Industry

In the Bureau of Plant Industry the Department's activities are concerned with the cultural requirements of the crop, the improvement of varieties, the development of new varieties through breeding and selection and varietal studies for the purpose of classifying those now in cultivation. This work of which I have the honor to be leader, is carried on by the Office of Horticultural and Pomological Investigations. The study of potato diseases is assigned to the Office of Cotton, Truck and Forage Crop Diseases. The studies along these lines include all the diseases to which the potato is heir. Much important information relative to certain types of diseases has been secured and methods for their control devised. It should be said that much of the work of the Department is conducted in co-operation with State Experiment Stations, colleges, and extension workers, and much of its success should be credited to these able co-operators.

United States
Government
seeking high
yielding dis-
ease free pota-
toes of every
leading com-
mercial vari-
ety grown in
Minnesota

Soil Fertility Studies

The Office of Soil Fertility Investigations is a comparatively new office of the Bureau of Plant Industry, having recently been severed from the Bureau of Soils. The function of this office is to study the nutrition of the plant and the relation of a properly balanced plant food to the health, vigor and productivity of the potato plant. During the past two years some very interesting data have been secured relative to lack of potash and its injurious effect upon the potato.

Other Bureaus

The nutritive value of the potato as a human food has served as the basis of some very careful studies by the Office of Home Economics of the States Relation Service.

The Bureau of Entomology gives considerable attention to the insect enemies of the potato and methods for controlling the same.

The Federal Quarantine Board strives to protect the potato growers of this country from further insect and fungus pests by maintaining a strict quarantine against foreign imports from suspected areas and in making careful examination of all other material coming into the country from non-quarantined territories.

The Insecticide Board has for the past few years been carrying on a very exhaustive study of fungicidal preparations with a view to determining the best and most economical spray materials and methods for the prevention or control of potato diseases.

Co-operation with Minnesota

It will be readily seen from the foregoing rather brief outline that the potato activities of the Department are many and varied and that it would be impossible to discuss in detail every phase of the work now under way. I am therefore, going to content myself by discussing at greater length those activities in which I have a part. You will be most interested I be-



UNCLE SAM BOOSTING POTATO IMPROVEMENT.

lieve in the work which we have undertaken co-operatively with your State Experiment Station. This work is being conducted along two quite distinct lines, the first being an effort to secure a highly prolific disease free strain of each of your leading commercial varieties. The plan adopted is to secure seed stocks of these varieties from growers who are known to have good seed securing from 5 to 10 lots from as many individual growers of each of the varieties, and testing them out side by side at your North Central Experimental Farm. These are carefully studied during the growing season with reference to the presence of diseases, freedom from mixture and apparent vigor of the stock. All weak and diseased plants are removed from the desirable lots and when harvested the resultant crop is very carefully studied with a view to the selection of the best performing strain. The seed of this lot is saved and planted on a half acre or acre basis the ensuing year for the purpose of securing a sufficiently large stock to permit of a rather wide distribution the following season. It is the intention of those carrying on this work to charge a fair price for this seed stock. All sales are to be handled by a representative of your Experiment Station, and the proceeds received therefrom are to be applied to the cost of growing the crop. It must be apparent to all

of you that the ultimate success of such an attempt at seed potato improvement must rest largely upon the co-operation it receives from those who are interested in the betterment of the seed potato industry in your state.

Aims of Work

As an illustration of what the outcome of this work may be I would like to call your attention to what has been secured in a similar work in Wisconsin. In order to make my illustration clear to you I shall have to anticipate the second line of work to which I wish to direct attention by saying that a certain strain of Triumph seed secured in Wisconsin last fall for trial at points in Louisiana, Texas, Oklahoma and Arkansas, nine points in all, showed up markedly superior to any other from Michigan, Wisconsin, Minnesota, North Dakota, or Maine, this past season. Seed from the same source was grown at the Spooner Branch in comparison with 10 other lots and again proved superior to all others. Steps have been taken to have the grower of this seed stock reserve his whole crop for sale to seed growers in Wisconsin. This is simply an illustration of how such a plan may bring to light a superior lot of seed stock which might otherwise have been unnoticed, and thereby making it available to as large a number of growers as possible. Surely no one will say such efforts are not worth while, nor do we believe that the necessary co-operation from the potato growers of this state will not be forthcoming.

Establishing a Market

The second line of work which we have undertaken is that of an attempt to demonstrate to the southern potato grower

that certified northern grown seed is superior to the general run of seed stock offered by the trade. The variety tested was that of the Triumph which is the leading early commercial variety of potato grown in the states mentioned above. The plan pursued was to purchase three lots of certified Wisconsin grown seed, three lots of recommended seed from Minnesota, six lots from Nebraska, three each of dry land and irrigated seed and one lot each from Maine, Michigan, and North Dakota. These were grown at Calhoun and Baton Rouge, Louisiana; College Station, Troup and Lubbock, Texas; Stillwater and Ft. Gibson, Oklahoma; and Fayetteville and Ft. Smith, Arkansas. The results of these trials while necessarily inconclusive showed a rather wide variation in the various lots under trial. Sufficient was learned, however, through this one trial to permit me to say that there is room for improvement in most of the lots tested. It is proposed to continue this study for several years and it is greatly to the interest of all growers of Triumph seed stock in the State of Minnesota that they assist in every way possible to make this a fair and just trial and to endeavor to improve their own seed stock either through the selection of seed from the most vigorous and productive plants or through the purchase of a superior strain of seed. The seed certification system now in effect in your state should do much to raise the standard of seed stock provided you take advantage of its provisions.

In closing I venture the prediction that the next five years will witness a greater improvement in the quality of seed potatoes grown in your state, than has been accomplished in the past fifty years.

THE BOYS' AND GIRLS' POTATO GROWING CLUBS

T. A. ERICKSON

Five thousand potato demonstration plots with five thousand boys and girls getting more and more interested in the standard varieties of potatoes and the best methods of producing them is the record of five years of Minnesota Potato Clubs.

The potato club work was organized five years ago as a part of the regular Boys' and Girls' Club work of the state. The minimum size of plot required has been one-eighth acre, although many club members have cultivated much larger plots. The first two years the work was limited to three standard varieties: Rural New Yorker, Green Mountain and Early Ohio. The first two years, the potato work was confined to northern Minnesota, but since then it has included the entire state, while club members have been allowed to select any one of the eight standard varieties named for Minnesota.

Northern Minnesota Development Association

While this work has been organized as a part of the Boys' and Girls' Club work carried on by the Agricultural Extension Division of the University, much credit for the success of the work is due to the Agricultural Committee of the Northern Minnesota Development Association for helping to plan the work in the beginning and in promoting it each year. The final potato show has been held each year in connection with the annual meeting of the Northern Minnesota Development Association, and this association has each year provided a premium fund of \$300.

First Show

At the first potato show held at Bemidji in 1915, the boys and girls showed more than 200 excellent exhibits of the three

5,000 BOYS AND GIRLS
in Minnesota
Interested in Growing the best of
POTATOES
BY THE
BEST METHODS
THROUGH THE
BOYS' AND GIRLS' CLUBS

For particulars write to your county agent or to Extension Division,
University Farm, St. Paul.



A SCHOOL POTATO FAIR IN ST. LOUIS COUNTY. THIRTY-FOUR SUCH FAIRS WERE HELD IN THIS COUNTY IN 1918.



LAKE COUNTY POTATO CLUB, DISTRICT NO. 2, TWO HARBORS.

Taught "Dad" A Lesson

"When father saw that I was able to grow 400 bushels to the acre of fine potatoes on the same kind of land on which he grew 135 bushels an acre of rough, scabby ones, he was anxious to get my seed, and to use the methods I was using as a club member."

—A Minnesota Boy Potato Grower.

standard varieties selected. These exhibits have improved in number and quality each year. The local and county exhibits, however, have been just as productive of good results as the state show. Each year, many small shows have been held in local communities where the boys and girls of one school or more have brought their potatoes to the schoolhouse to be compared and judged. Small prizes have been given, and the boys and girls have been assisted in improving their selections.

In St. Louis County alone last year, thirty-four of these small potato fairs were held, where nearly 400 samples of good potatoes were shown and judged. A great many of the parents attended at the close of these fairs. The county agent, Mr. Larsen, stated that he knew no other way in which with the same amount of effort so much good could be accomplished for the potato industry in particular, and for agriculture in general in northern Minnesota.

Varieties Standardized

One of the many good results of this work has been the introduction of standard varieties and of better seed. The Boys' and Girls' Potato Club plots have generally been the potato seed plot for the farm. County agents, county superintendents of schools, and the leaders of the work have selected one or two standard varieties for each county, and have made a great effort to distribute good seed of the varieties selected.

In this way "scrub" potatoes have been weeded out of entire communities, through the work with the boys and girls. One potato club boy put it just right when he said in his story: "When Father saw that I was able to grow 400 bushels to the acre of fine potatoes on the same kind of land on which he grew 135 bushels per acre of rough, scabby ones, he was anxious to get my seed, and to use the methods I was using as a club member."

Yields

This article would not be complete without the story side of the work. Many wonderful records have been made: In 1915, Oscar Larson of Marshall County, grew 605 $\frac{1}{2}$ bushels of Green Mountain tubers on his acre, which was a national record on non-irrigated land, at that time by potato club members. In 1916, Ruth Ehnstrom of Carlton, made the state record with 440 of Rural New Yorkers to the acre. Joseph Walsh of Lake County won state honors in 1917, and Geo. Gaylord of Becker County, in 1918, with the splendid yield of 623 bushels of King potatoes.

The best average yield by club members of any one county has been made by a club of Itasca County which has won the state record as a club for four successive years, with the wonderful average yield of

340 for 1916, 346 for 1917, 323 bushels for 1918 and 415 for 1919. The club has included from five to ten members. Sophie Holmson of Carlton, is now sixteen years of age, has won first place on her Rural New-Yorkers at four state exhibits. This girl's record is especially fine for we know that she has learned to know, grow and appreciate potatoes through the follow-up lessons and bulletins sent her as a club member.

Other Results

Gurhard Lorrentz of Polk County has grown Rural New-Yorkers until he was able in 1918 to send the highest scoring sample of this variety to the Crookston show, and to the Minnesota Crop Improvement Association show at St. Cloud.

Through the potato club work scores of



THE ITASCA COUNTY BOYS' POTATO CLUB, WITH A RECORD FOR STATE FOR THREE YEARS



SELECTING POTATOES FOR AN EXHIBIT, ST. LOUIS COUNTY CLUB MEMBER

communities have been persuaded to grow the same variety.

The potato club work has done much to create interest in recognized potato diseases, and best methods of combating them. Each year, the potato specialists have had as able assistants these 1,000 or more potato club members who are always looking for, and ready to combat the new, and generally unknown, potato diseases.

Scores of times, the writer has visited potato plots and has been told by the

young growers of the troubles they have had with certain diseases, and how they have successfully overcome them.

Another very important result of the potato club work in northern Minnesota has been to open a great many homes to other improved methods in agriculture and home-making. Many of these foreign-speaking homes have been inaccessible to progressive methods, but with their own boys and girls demonstrating to them these better methods, the "ice has been broken" for improved methods in general.

POTATO CULTURAL METHODS

By T. M. McCALL, CROOKSTON, MINN.

Potatoes, when disease free, and when given a fair chance will yield fair to good crops on practically all types of agricultural soils found in the state. The potato is the chief cultivated crop of northern and northwestern Minnesota; elsewhere in the state it is grown as a cash crop or for home use in conjunction with other cultivated, grass, and grain crops.

The potato, because of its great adaptability to the varying soil types, makes profitable yields generally without a great deal of special attention; and because of this fact many growers in seasons of good prices have become careless not only in methods of production but in methods of handling. Carelessness in potato growing ultimately reacts on the producer.

The potato as a crop responds better to care and attention and pays better for the extra intelligent labor used in its production than any of the other common field crops grown in the state. The time is not far distant when it will be imperative that we grow much greater quantities of food per acre than we are now producing.

Demonstrations in practically every county have proved that potato yields can be doubled or trebled by careful selection, seed treatment and spraying together with good cultivation. For this reason the potato offers great possibilities as a cash crop to the growers who will spend time in its selection and improvement.

Avoid Weedy and Run Down Soil for Potatoes

Potatoes do not add fertility to the soil. Many growers think that because grain crops yield better returns after potatoes than after small grain that the potato adds fertility to the soil; and the conclusion is drawn that the potatoes may be planted on poor worn out land.

Such conclusions are incorrect. Soils men tell us that the potato crop has much the same effect on soils as the bare fallow. Moisture is conserved, surface weeds are killed and plant food liberated by the thorough cultivation. These factors are responsible for the high grain yields the following year.

A good, friable, free working loam is ideal for potatoes. Newly cleared sandy or clay loams generally produce greater yields than the same soil types under prairie conditions. Physical condition, or soil texture is apparently of greater importance than soil type in potato production. The crop needs an abundance of food materials hence the soil should be rich, and the soil must be of mellow texture for the best tuber development. Sandy soils, in order to produce a good crop of potatoes, must be fed barnyard manure, and any leguminous crop such as clover, alfalfa, beans, peas, may be grown on the land and plowed under or used as soiling crops if necessary. Heavy clay soils must be made mellow. Hard, compact soils can be mellowed by fall plowing, by fertilizing with barnyard manures by growing leguminous crops preceding potatoes. Minnesota growers should not be deluded by the results obtained from the use of commercial fertilizers in other sections and think that commercial fertilizers are the universal panacea for all poor yielding soils. If the common known practices for restoring worn out soils to high yielding powers fail, then a grower is justified in supplying the needed elements in the form of commercial fertilizers. Contrary to the practice common in many sections, the best land on the farm is none too good for potatoes; for greater net profit can be made from a 300-bushel yield from ten acres than a 100-bushel yield from 30 acres.

Potatoes Do Not Kill Weeds

Potato yields on the other hand may be much reduced by uncontrolled weeds. Potato diggers do shake out and destroy the roots of quack grass, sow thistle and other perennial weeds that may be in the potato row but it can readily be seen that a more effective grass seeder for those weeds would be hard to find. "Potatoes are hard on quack grass," is a common expression but those who have tried quack grass eradication by this method know that complete eradication is costly work; and that if eradication is not complete that the reverse of the adage is true.

Soil Preparation

Preparation for the potato crop should be made at least one or two years previous to planting of the crop. A good coating of manure can best be applied upon the clover or grass crop preceding potatoes. If this cannot be done the manure, if quite well decomposed, may be applied directly to the potato crop. Six to ten tons of manure per acre, preferably before plowing, would be a good application. Fall plowing is recommended for all clay or heavy loam soils for nature can accomplish more in one winter's freezes and thaws in mellowing such soils than man can do with any amount of work. Light, sandy soils or soils that are inclined to "blow" should be plowed in the spring. Heavy soils plowed in the spring, bake more easily, are more difficult to work, and cannot withstand drought as well as when fall plowed.

One or two crops of weeds can be destroyed in the spring by discing or harrowing before planting. Land that is worked early and is not allowed to bake warms up early and gives the seed a good start.

Seed Selection and Treatment

It pays to select seed potatoes for type. Early Ohio potatoes selected for type each year from the bin at the Crookston Station have far outyielded ordinary field run or bin run seed. Where the

"run out" or degenerate types are eliminated a more uniform lot of potatoes will be produced. The results from such selections are generally very marked the first season.

The corrosive sublimate treatment together with stem clipping for the seed plot have proved to be the most effective control measures for tuber diseases. Very profitable increases in yields have been obtained from the use of the corrosive sublimate seed treatment. The tubers from the treated plots have invariably been clean and bright as contrasted with the tubers from untreated plots.

Size of Seed and Amount per Acre

Great diversity of opinion exists as to the best size of seed pieces, the distance of planting and the amount of seed per acre. Every size of seed piece from a potato paring to a large whole potato has its adherents. To solve this problem the Crookston Station has, during the past eight seasons, made comparative tests of eight sizes of seed pieces including four sizes of whole potatoes ranging from small 1.5-ounce tubers to tubers weighing 10 ounces. Cut seed pieces ranging from single eye cuttings of one ounce to halves weighing 2 ounces were used. Different amounts of seed per acre were planted in which the different distances of planting were noted as well as the size of seed. The following conclusions have been drawn from these tests:

1. Whole tubers when planted produce greater total yields than cut seed pieces.

2. Price of seed and economy of labor in planting considered, the quartered seed from four to five ounce tubers has proved most profitable.

3. The proper distance for planting in the row varies with the character of vine growth. The best results were obtained with Early Ohio when the seed pieces were dropped eleven inches in the row. With rows three feet and set eleven inches in the row, sixteen

bushels of seed were required per acre using one ounce seed pieces.

Planting the Crop

The seed pieces must be uniform in size to secure an even drop with any type of mechanical planter. Any good make of one-man planter in good repair can generally be depended upon to make a 95% to 98% drop. Poor stands from sound seed often trace back to carelessness in cutting methods. With the present types of machine seed cutters it is quite impossible to uniformly size the seed piece when the tubers vary in size. Hence, hand-cutting with the stationary knife is one of the most practical cutting methods devised to date.

The seed should be planted about four inches deep. For land that has been well prepared this depth is not too great. Seed planted four inches does not show the line of row as quickly as shallow planted seed. Vines developing from the deep planting can better withstand the varying weather conditions of summer and are less liable to form second growths than the shallow planted seed.

Cultivation of the Crop

Cultivation of the potato ground accomplishes three important results, namely, the elimination of weeds, the conservation of moisture, aeration of soil, increasing its temperature, and the making of plant food available.

Very little, if any, hand labor is necessary in controlling weeds if the proper horse implements are used at the proper time. Cultivation should be begun as soon as the crop is planted. The common corn cultivator can be used for the first so-called "blind" cultivation. Thorough surface cultivation is preferred. The sweep or duck foot type of shovel can be procured for any type of corn cultivator and by fitting up the two outer shanks of each gang of the six-shovel corn cultivator an excellent weed killer and surface cultivator can be made.

A light harrow or weeder run crosswise of the row when the first sprouts are out

of the ground generally kills all of the weeds in the row. The harrow or weeder should do little, if any, damage if the seed is planted the proper depth.

Four or five cultivations generally are necessary after the potatoes are up, to preserve the dust mulch and keep the ground from baking after rains.

Level culture has proved best when the seed has been planted the right depth. In seasons of wet weather ridging is sometimes necessary to give drainage between rows, and thus prevent smothering.

Spraying

It is generally known that leaves are necessary for the production of tubers on the potato. The starch is made in the leaves and we know that if the leaves are killed by disease or eaten off by insects tuber development stops. Every grower should be fully equipped to spray for insects and diseases for it is not an uncommon sight to see entire fields destroyed by potato beetles for the lack of timely work in spraying. Early Blight often kills the foliage one or two weeks before maturity, decreasing the yield, while Late Blight, if uncontrolled, may destroy the whole crop. These diseases and insects can be controlled.

From various tests made by the writer of the many poisons for potato beetles, Paris Green has proved most dependable. Lead Arsenate and Calcium Arsenate have proved effective but are slower in action than Paris Green. The spray adheres to the foliage better when one pound of slaked lime paste is strained into the tank for each pound of poison. The spray solution should be applied as a fine mist and for that reason the sprayers equipped with good pumping outfits and good nozzles are generally most economical even though the initial cost is high.

The number of sprayings necessary to control beetles varies from year to year. However, data collected from the Red River Valley show that three sprayings with Bordeaux mixture gave the most profitable returns. It was found that by

combining the Paris Green with the Bordeaux and beginning to spray when the first beetle injury was noted (when plants were three to six inches high) and spraying two more times at intervals of ten days to two weeks, that beetles were controlled and that vines had a good coating of Bordeaux. Frequent showers may wash off the poison and necessitate extra spraying in wet seasons. The writer has sprayed as many as five times for beetles.

Harvesting the Crop

Not much progress has been made in recent years in improving potato harvesting methods. Small gasoline engines have replaced some of the horse labor required in digging and a few promising types of picking and elevating devices have appeared on the market. Mechanical devices for picking do not differentiate between stones, clods of earth and potatoes, hence at best, hand-sorting is quite necessary.

Great losses sustained by growers generally arise from careless methods of handling. The potato is a perishable crop and is subject to injury all the way from the digger to the car or warehouse. A good man is required to operate a potato digger successfully. With the digger set to get under the hills, and with the team kept steady, digger injury can be reduced to a minimum. Unless the potatoes can be kept from spreading in the row behind

the digger, it would be best to dig alternate rows.

Field injury can be kept down by careful picking methods. The potatoes should be handled as little as possible in getting them from the field into the warehouse. Many growers are now using bushel slat crates, the pickers picking into the crates in the field, often two working together. These crates are then hauled to the warehouse and dumped on sorters where they are sacked.

Whatever method of harvesting is used, the grower should aim to reduce the injury to the tubers to the lowest possible minimum.

In conclusion, a man going into the potato-producing business should be growing the right variety for his soil and market. He must know his variety absolutely.

The land for the crop should be the best the farm affords.

The acreage should be limited to fit into the other farm work to best advantage.

Good, substantial machinery should be used.

Seed should be treated with corrosive sublimate to kill disease germs.

Clean cultivation should be used.

Spraying should be effective.

Care should be taken in harvesting methods to reduce injury to the minimum

MY EXPERIENCE IN GROWING POTATOES

E. W. SMITH, PARKERS PRAIRIE

I began growing potatoes for the market some thirty-five years ago. At that time no effort had been made to standardize varieties. We just grew potatoes, sometimes as many as eight or ten different kinds in the same field. The yield was around 90 to 100 bushels per acre. By good cultivation I managed to produce about 100 bushels per acre and thought I was doing well because I was up to the average.

Inspiration from Institute

One day I attended a Farmers' Institute where a gentleman from New York spoke on potato culture. He emphasized the importance of selecting a standard variety, selecting the best type, preparing the seed bed before planting, good cultivation and the best of care all along the line. Early in my career I just went into the cellar at planting time and shoveled up the number of bushels I wanted to plant and used all of these and hoped for the best. After the Farmers' Institute, I hand-picked from the bin enough potatoes to plant ten acres. All of the tubers selected were true to type and of average size. They were all treated for scab and other diseases that potatoes are heir to.

Size of Seed Pieces

The potatoes were cut to about two-ounce pieces. I have learned that the size of the seed piece is of more importance than the number of eyes it contains,

provided there is at least one eye. I used care in handling the seed after it was cut, never piling it in large quantities or putting it in cotton sacks, barrels or boxes. I usually cut about one bushel of seed at a time and spread it on a clean floor until I was ready to plant. I find it advisable to cut and plant as soon as possible, or to plant at least within twenty-four hours after cutting. The place I selected for planting was the very best soil on the farm, and it was well prepared by deep plowing in the fall and frequent discing and dragging in the spring.

Cultivation

After planting I started the harrow, keeping the weeds down until the potatoes were up. Then the cultivator was started, running it as deep as I could the first time through the field. As soon as the potatoes showed much top I began to run the cultivator more shallow. I soon learned that the last cultivations should be done with a surface or Tower cultivator. By using this type of a machine I was enabled to keep a good dust blanket on top, to stop the evaporation of soil water, and also to avoid pruning the roots. I cultivate very late, sometimes within three weeks of digging time. Potatoes use a tremendous amount of water when they are growing, especially at the time the tubers are forming, and if we prune the roots by deep cultivation we prevent the plants from securing the required amount of moisture.

What is an Investment?

SOMETIMES it is time and labor.

E. W. SMITH of Parkers Prairie thought he was doing fairly well when he grew 100 bushels of potatoes to the acre.

HE INVESTED time and labor, according to instructions from a speaker at a farmers' institute.

NOW he grows an average of 200 bushels to the acre.

That was an Investment!

It has paid big dividends

Spraying

I kept a watchful eye at all times on the bugs and applied poison liberally when needed. My rule is to use four pounds of Paris Green or two pounds of Paris Green and three pounds of Arsenate of Lead to a fifty-gallon sprayer. Applying the spray about twice during the season is sufficient.

After adopting this more modern method and after selecting standard varieties best suited to my conditions, I succeeded in raising my average yield from 100 bushels per acre to 200 bushels, and I seem to make improvement as the years advance.

Marketing

I prefer to sell at digging time if I possibly can, loading directly into the wagon and hauling to market. As I live nine miles from the nearest market it is impossible for me to sell all of my crop immediately. Therefore, one-half or two-thirds of my crop has to go into my cellar and I sell these mostly in the

spring but there is always a big shrinkage.

I always try to plant about the same acreage year after year, let the prospects be what they may and I have never lost any money on my potato crop. This I cannot say about other crops. I give the humble spud the credit for securing for me my comfortable home shown above, for educating my children and for keeping myself out of mischief.



I LIKE TO LOOK AROUND ONCE IN A WHILE TO SEE THE TUBERS AS THEY COME OVER THE DIGGER.

It Pays

TO SELECT
Seed Potatoes
FOR TYPE

PRACTICAL POINTERS ABOUT POTATOES

By H. J. BALDWIN, NORTHFIELD

The writer has practiced what is called sun sprouting of potatoes for over twenty-five years and no doubt many will be interested to know something about the process.

Reason for Sprouting

I am of the opinion that the seed that has been subjected to a strong light for some time becomes more free from the diseases that are so common near the skin. The Experiment Station has promised to make a test along this line to see if scab and other diseases cannot be eliminated by sun treating.

Both the Ohios and Rurals sprout well. Do not hurry the planting until the ground is warm enough so that the potatoes come on quickly. Some years one gets better results than others but as a rule they ought to be two or three weeks earlier in maturing.

In sprouting the later Rurals I find I get a much earlier growth and thereby take advantage of the spring moisture. When the sun sprouted potatoes are taken out to plant let them set in the sun a few hours and then after cutting scarcely a sprout will break off. The only precaution I take is to pick up only one piece at a time from the measure I am dropping from.

Treat First

If the potatoes are at all scabby or diseased they should first be soaked in corrosive sublimate solution. This solution is made by taking two ounces of corrosive sublimate, put in wooden cask or barrel, pour on a gallon of boiling water to dissolve quickly, then dilute to fifteen

gallons; soak potatoes for ninety minutes. The same solution can be used twice and then if used again soak two hours for the next two soakings. If the solution is used again more corrosive sublimate should be added by adding one ounce to one gallon of water to the solution when another four soakings can be made as before. Our Wisconsin potato men have worked this out for our benefit.

Sprout in Shallow Crates

As soon as the potatoes are dry place them in shallow crates with seed end up, pack in closely, and do not disturb until they are taken to the field to plant. I have found a convenient crate to be made four feet long, using two six-inch boards having a half-inch space between. Nail a short piece of inch board on ends to hold them together, having piece about four inches wide and placed in such a way as to form end of tray two inches deep. A half-inch piece of same width nailed to the edges of the boards completes the tray.

If several trays are to be used they can readily be piled one on top of another by nailing short legs of ten or twelve-inch length into the corners of the tray. These support the upper tray, allowing light and air to come to each potato. In this way ten bushels can be sprouted at a single window in cellar or store-room where it does not freeze. The potatoes may be left in a dark warm place for the first ten days if they have not sprouted as yet but they ought not to be allowed to start out long sprouts.

THE FARM POTATO PATCH

R. S. MACKINTOSH

The farm potato patch is supposed to supply the family table with a substantial and important food product that is generally used one or more times each day in the year. In fact, the potato as human food, is only outranked by wheat. In Minnesota the potato is grown extensively both as a commercial crop and to supply the home table. The crop each year averages about 30,000,000 bushels.

The other articles in this publication describe the many phases of potato production largely from the commercial side. This article tries to bring out the chief points to be considered in raising a supply of potatoes for home use.

Selection of Seed

The home table should be supplied with the best that can be produced. The seed potatoes used should be selected carefully so as to have as good potatoes as possible. Too much attention cannot be given to selecting a variety suited to the soil and local conditions. It is usually desirable to have two varieties, one early and one late. The ideal time to select the seed is while digging. Those hills having the most potatoes of a uniform size, shape and quality are the ones to select for seed purposes. The next best way is to select from the cellar supply the potatoes which are the most perfect. Store them in a separate place where it is cool and dark so that they will not sprout too quickly. The nearer the temperature is to thirty-two degrees, or freezing, the better.

Soils

The potato does best when the soil conditions are ideal. This means a deep loam or sandy loam soil well filled with available plant food. Potatoes should not be planted year after year in the same place unless absolutely necessary. A four or five-year rotation is better. The potato crop should follow the clover in

the rotation. This permits the application of liberal supplies of manure on the clover the year before the potatoes are planted. In other words, give the potato a fair chance and do not expect a big crop when planted in any out-of-the-way place.

Planting

For very early use, plant two or three weeks before the last killing frost is expected. This statement is not very definite but in a state the size of Minnesota it is impossible to name an exact date. Some risk has to be taken if earliness is to be considered. See charts on Page 00, showing average dates of last killing frost in the spring. The late varieties should be planted several weeks later.

It is always easier to keep potato diseases out than it is to destroy them after they have become established. Therefore, examine the seed potatoes carefully and treat as recommended even if no signs of tuber diseases appear.

Carefully conducted field tests show that the largest yields are obtained when the potato is planted without cutting at all. The most profitable yields are obtained when potatoes are cut into four pieces. Such pieces should weigh from one and one-half to two ounces each.

The distance between rows varies according to conditions, but 32 to 36 inches is generally best, with hills from 12 to 20 inches apart. The seed pieces should be placed from three to five inches below the surface. If the soil is ridged over the row it helps in controlling the weeds that start very early. A light harrow may be used to level the surface and destroy the young weeds.

Spraying

The potato beetle, scab, blight and other insects and diseases injure the home potato patch the same as they do the commercial fields. It is advisable to follow this plan:

1. Discard all potatoes that show scab, dry rot, rhizoctonia, or are imperfect in any particular. (See Pages 78 to 84.)
2. Cut a thin slice off the stem end and discard all tubers showing any ring discolorations. (See Page 78.)
3. Disinfect all seed by soaking in formaldehyde or corrosive sublimate as described on Page 83.
4. When vines are from 6 to 12 inches high spray with arsenate of lead or Paris Green for beetles, and Bordeaux mixture for fungus diseases. For best results spray vines two or three times as described on Page 96.

Spraying pays. Do not allow insects and diseases to eat the potato vines or tubers.

Cultivation

Cultivation should be frequent so as to keep the surface loose and prevent weeds getting a foothold. The easiest time to kill weeds is just as they start. The roots at that time are undeveloped and exposure to the sun and air soon dries them up. The main object of cultivation should be to keep the soil in best condition to permit the potato to grow, rather than to kill weeds. The use of a light harrow, weeder or similar implement may be used until the potato sprouts are above the surface and after that single or double horse cultivators may be used.

Digging

As soon as the tubers are large enough they may be used to supply the table. At first the tubers may be removed without disturbing the plant but later the entire plant is dug out. The crop for winter use should be dug before there is danger of injury from freezing. If possible dig when the soil is reasonably dry, to prevent too much soil adhering to the tubers.

Saving Seed

As the hills are dug be sure to save the best hills for seed purposes the following year, as described under selection of seed.

Varieties

The Early Ohio is the principal early variety grown in the state. It does well over a wide range of soils. The two other

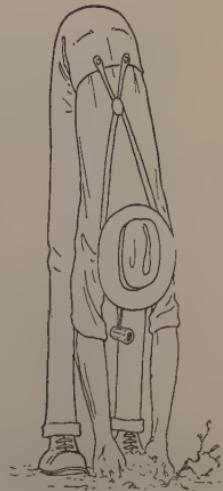
early varieties recommended for the state are Triumph, and Irish Cobbler.

The Rural New-Yorker and Green Mountain are the two principal late varieties. The Green Mountain is preferred in parts of the state, while Burbank, Burbank Russet, and King, are grown in certain sections. It is best to choose varieties that have proved most desirable in the community instead of trying varieties that are too highly advertised. Extensive tests carried on by our experiment stations show that many varieties have many names or aliases. See description of standard varieties, Page 21.

Storing

Potatoes may keep reasonably well if stored in almost any manner. It is best to store the potatoes in bins and not over five feet deep. If cool air can circulate under and around the potatoes so much the better. In modern houses the heating plant often warms the air too much so a special room is partitioned off and ventilated directly from the outside. In such cellars barrels make good receptacles for storing the winter supply. Potatoes keep best in cool (thirty-five to forty degrees), slightly moist places. If the air is dry they shrink too much. If too warm they sprout too soon.

POTATOES FOR SEED
SHOULD BE DUG BY
HAND



PLACE OF THE POTATO CROP IN THE CROP PLAN

A. D. WILSON

A good arrangement of crops on a farm usually provides for three classes of crops; namely, grain crops, grass crops, and cultivated crops. The effect of each of these classes of crops on the soil is quite different. Grain crops use more vegetable matter than they return to the soil, and also generally allow the land to become quite weedy. Grass crops have just the opposite effect—they add vegetable matter to the soil, even though the crop is harvested and removed they have a tendency to at least check the growth of weeds.

Importance of a Cultivated Crop

A cultivated crop, such as corn, potatoes, or root crops has the effect of grain crops—in using up the vegetable matter in the soil. But because of the inter-tillage it stimulates decomposition and uses up vegetable matter more rapidly than grain crops. On the other hand, cultivated crops have the effect of grass crops (and in a greater degree, if properly cultivated), of destroying weeds. In addition to these characteristics, the cultivated crops may also practically take the place of summer fallowing. The objects of summer fallowing are largely to destroy weeds, to conserve moisture and to aid in the changing of plant food from an insoluble to a soluble form. All these things are accomplished very nicely by the cultivated crop. In fact, in the humid sections of the country where there is a reasonable rainfall of twenty inches or more per year, the growing of a cultivated crop is just as valuable to the soil as is summer fallow; that is, in stimulating the soil for a larger crop production the following year. A cultivated crop, however, has the advantage over summer fallow of turning a valuable product and quite often the growing of a cultivated crop tends to produce more feed on the farm which is fed to live stock, and this

in turn adds to the productivity of the soil.

Potatoes

The total acreage of potatoes in the State of Minnesota is small compared with the corn acreage. As a matter of fact, there are about nine times as many acres of corn growing in the state as of potatoes. However, many of the important potato growing sections of the state are not in the sections that are producing corn generally, and consequently the potato crop in these sections is a very desirable crop in the rotation for providing the cultivated crop desired.

Three-Year Rotation for Potatoes

Many of the successful potato growers, especially on the lighter soils, have gotten most excellent results from a three-year rotation; of first year, grain; second year, clover; and third year, potatoes. This simple rotation meets all the requirements of a good rotation. It provides for the grain crop following a cultivated crop, which usually brings good results. It provides a grain crop as a nurse crop for the coming clover, and the cultivation of the potato crop the preceding year has put the soil in excellent condition for the young clover plants to succeed in with the grain crop. This insures generally a good stand of clover which, of course, means a good crop of hay, and a good soil building crop as well. Such a rotation usually means that stock will be kept on a farm to utilize the crop of hay. This, of course, results in having manure for the land. Clover sod with a light dressing of manure applied makes an ideal place for the coming potato crop.

Four-Year Rotation

Even on light soils if this sort of rotation has been practiced for some years it often results in building up the soil

to a point where the grain crop is likely to lodge. This makes it desirable to modify the rotation, and some growers have found that by changing to a four-year rotation and growing two cultivated crops, following the clover, one crop of corn, and one of potatoes, they have been able to get excellent crops and check somewhat the tendency of the grain to lodge. It has not been demonstrated yet which is the better order of growing these two cultivated crops; that is, which one should be grown first. It is the writer's judgment that the better plan is to grow the potatoes on the clover sod, then follow this with a crop of corn, for the reason that if the corn is grown first the corn stubble may cause some trouble in the cultivation of the field for potatoes.

Five-Year Rotation

Another rotation that has worked out splendidly at University Farm is a five-year rotation, consisting of crops in the following order: wheat, meadow, pasture, oats and corn. For the last twenty years this rotation has given yields of approximately twice the average yields in the State of Minnesota. In this rotation the land gets eight loads of manure per acre once every five years. This manure is applied to the corn crop. This rotation would, of course, work out approximately the same way if potatoes were planted in place of corn, or what would work out desirably on a great many farms would be to divide up the field in cultivated crops between corn and potatoes. Such a rotation, of course, provides for rotation pasture. On many farms this is desirable.

THE TOLL OF POTATO DISEASES

G. R. BISBY AND F. JEAN MACINNES

Each year the Section of Plant Pathology at University Farm keeps as accurate a record as is possible of the losses from plant diseases. This article lists the losses from potato diseases for the season of 1918 and explains how the figures given were obtained.

The Bureau of Markets of the United States Department of Agriculture has inspectors stationed at various terminal markets, who inspect and report on the condition of potatoes being shipped into these various markets. Table 1 gives the results of these reports for Minnesota. To explain the figures presented in this table, we may examine the first disease, scab. The inspectors sent in 150 reports giving in each case a certain per cent of scab. The average of these 150 reports gave 7.1 per cent as the average when the disease was reported. A total of 344 reports was received, however, 194 of which did not mention scab, indicating that it was absent, or present only in rather negli-

gible quantities. This gives an average of 3.1 per cent of scab for all reports. Our observations through the state had shown that the disease was generally distributed. Obviously however, 3 per cent of scab does not mean the loss of 3 per cent of the crop. An estimate of 1 per cent is, however, conservative. Since the crop harvested in Minnesota was about 30,000,000 bushels, scab caused a loss of about 300,000 bushels. In 1918 potatoes brought about 50 cents per bushel or more to the grower. The loss was easily \$150,000.

In addition to the reports sent in by the Bureau of Markets, we keep a careful record of information obtained when traveling in various parts of the state, and of various reports that come in. These data are also drawn upon in figuring the losses.

Late blight was of limited occurrence in 1918, though it has been very serious in some years. Dry rot of the tubers was,

however, very common and serious. Nearly seven per cent of the crop shipped out of the state showed the disease. Since dry rot usually destroys the tuber for cooking or seed purposes, and since many rotted tubers would be sorted out before shipping, a loss of five per cent is doubtless conservative.

The loss from the other diseases was similarly figured. Adding the losses in Tables I and II, we find that 17 per cent of the crop was lost, which means, figuring on the basis of thirty million bushels, a loss of 5,100,000 bushels, worth easily \$2,550,-

000. A more accurate method of figuring the loss would be that of considering 17 per cent of the crop destroyed, and therefore, only 83 per cent of a crop was produced. If 30,000,000 bushels is 83 per cent, 100 per cent, or a crop without diseases, would be over 36,100,000 bushels. Few will doubt that a crop absolutely free from disease would have been greater than 36,000,000 bushels in Minnesota in 1918.

The figures for 1919 are not yet prepared, but will doubtless be similar to those of 1918.

Table I. Storage diseases of tubers as found in transportation

Disease	No. reports having percentage of damage indicated	Ave. percentage of disease on these reports	Total No. reports on tuber diseases	Average percentage of disease	Relative prevalence in state	Estimated loss to growers in Minnesota		
						Percentage	Bushels	Value at 50c per bu.
Scab.....	150	7.1	344	8.1	General	1.0	300,000	\$150,000
Late blight rot.....	16	16.0	344	.7	South & S. E. only	0.3	90,000	45,000
Dry rot...	201	11.5	344	6.7	General	5.0	1500,000	750,000
Soft rot...	43	6.7	344	.9	General	1.0	300,000	150,000
Black scurf	20	5.0	344	0.3	General	See dry stem rot		
Frost.....	6	16.0	344	0.3	Rare	Trace		
Total.....						7.3	2,190,000	\$1,095,000

Table II. Field Losses

Disease	Relative prevalence	Loss in bushels	Loss at 50c per bu.	Estimated percentage of crop lost
Early bright.....	Rather general	300,000	\$150,000	1.0
Black leg.....	Cent. & N. W.	900,000	450,000	3.0
Tipburn.....	General	600,000	300,000	2.0
Mosaic and dwarf.....	Gen. on Triumph especially	60,000	30,000	0.2
Dry stem rot.....	General	600,000	300,000	2.0
Wilt.....	Cent. & West	450,000	225,000	1.5
Leaf roll.....	Not common	....	....	Trace
Total.....		2,910,000	\$1,455,000	9.7

\$2,550,000 LOST!

THROUGH

Potato Diseases

IN

Minnesota Alone

IN 1918

“Some” tax on the Industry!
And most of it might have
been saved.

POTATO DISEASES

G. R. BISBY

The potato crop of Minnesota and of other states is reduced by a considerable percentage every year from the diseases which affect it. If these diseases were not preventable, if they were brought about only by weather or other unavoidable conditions, it would be useless to discuss them. The majority of the growers in the state realize, however, that most of these diseases are preventable, at least to a large extent. It is the purpose of this article to call attention to the seriousness of potato diseases, to point out the distinguishing characters of the various diseases, and to discuss briefly certain control measures.

About five million bushels of potatoes were lost from diseases in Minnesota in 1918 according to our best estimates, as explained in another page. These losses are to a considerable extent perpetuated through succeeding years when diseased stock is planted, especially if seed disinfection, crop rotation and other good practices are not employed. Those who have attempted to grow certified seed have had their attention particularly called to the seriousness of potato diseases.

The following key gives brief distinguishing characters for the most serious diseases which occur in Minnesota:

Key to Minnesota Potato Diseases

Leaf Diseases:

Leaves Only Affected:

Diseased spots on any portion of leaf, often with concentric markings. 1 Early Blight.

Diseased spots on tip or margin of leaf. 2 Tipburn.

Veins affected most seriously. 2a Hopperburn.

Veins least affected. 2b Sunscald.

Leaves, Tubers and Often Stems, Affected:

Spots on leaf watersoaked and

mouldy beneath when wet, irregular. 3 Late blight.

Leaves Mottled, Curled or 'Rolled, Whole Plant Affected: See Mosaic. Mosaic and Similar Diseases, Affecting the Whole Plant, but Manifest on Foliage Only:

Leaves mottled with darker green and lighter green or yellowish, often crinkled more or less. 4 Mosaic.

Leaves much crinkled, more or less mottled, plant dwarfed. 5 Mosaic Dwarf.

Leaves, especially lower, rolled, crisp; plant unthrifty. 6 Leaf Roll

Stem Diseases, Affecting Tubers Also:

Stems rotted throughout, black and slimy at first; tubers often rotted with a slimy soft rot. 7 Blackleg.

Stems rotted in definite areas, brown, not slimy (dry stem rot); tubers affected with black masses on surface (black scurf). 8 Rhizoctonia Disease.

Stems affected and browned internally, especially in sap tubes, sometimes whole lower stem browned; tubers with brown ring or a rot at stem end. 9 Wilt.

Tuber Diseases:

Tubers Affected Internally:

Hollow area near center. 10 Hollow Heart.

Black area inside tuber. 11 Black Heart.

Brown spots or lines inside tubers. 12 Net necrosis.

Brown ring or rot at stem end: See No. 9. 13 Brown Ring Discoloration.

Tubers Affected Only Externally:

Roundish corky spots without torn epidermis. 14 Common Scab.

Roundish powdery spots, smaller than preceding, epidermis torn. 15 Powdery Scab.

Black dirt-like masses on surface: See No. 8. 16 Black Scurf.

Silvery patches on skin of tuber. 17

Silver Scurf.

Tubers Affected Internally and Externally:

Wart-like swellings from eyes and elsewhere, roots often affected.

18 Black Wart.

Tubers soft, blackened inside, rather sweet. 19 Frost Injury.

Tubers green externally and somewhat internally. 20 Sunburn.

Tubers rotted, dry or wet. See 3 and 7. 21 Storage Rots.

Since there is not space for a detailed discussion of all the various potato diseases, methods of preventing or avoiding certain of them will be particularly discussed. Rather specific control measures for certain diseases or groups of diseases will be first considered, followed by some general methods for lessening the losses from potato diseases.

Diseases affecting the leaf (excepting the mosaic type of diseases) may be largely prevented by spraying with Bordeaux mixture. The manufacture and use of this preparation is described below. While Bordeaux mixture is employed particularly against late blight, it is also efficacious against tipburn and early blight, and when correctly used can be expected in any year to increase yields sufficiently to more than pay for its use. Late blight is fortunately of rather uncommon occurrence in Minnesota, and need be expected only about once in five years on the average. When it does appear, however, it may develop into an epidemic that will ruin a field that has not been sprayed. Early blight occurs to greater or lesser extent every year over most of the state. This disease is less serious on sprayed plants. The tipburn condition is brought about either by leaf hoppers, which affect the veins of the leaf and cause a death of the veins and adjacent tissue, or by the sun and by dryness, in which case the edges and tips turn brown, the veins being least affected. The application of Bordeaux mixture serves to repel the leaf hoppers, and to lessen the amount of dry-

ing of the leaves. Bordeaux mixture should be used more by those who are desirous of growing better potatoes and increasing their yields. Paris Green or lead arsenate may be combined with the Bordeaux mixture to kill insects.

The mosaic disease has attracted much attention the past year, particularly by growers of Bliss Triumph, since it has been found that almost all lots of the Triumph variety in the state are affected with this disease. Other varieties, such as the Green Mountain, have also been found infected to a slight extent. Since this disease has not been emphasized before as serious in this state, it is here discussed somewhat fully.

This disease was first described in 1914 by Orton, of the United States Department of Agriculture. He had observed it in Germany and in Maine; an examination by Dr. Orton in Minnesota in 1912 and 1913 did not reveal the disease, although the Triumph variety was probably not examined particularly. In the five years that have elapsed since Orton described the disease, its importance has become increasingly evident. Recently workers in the United States Department of Agriculture have shown that the disease is spread from plant to plant by certain insects, although the symptoms are slow to appear, and often do not become evident until the following year, when tubers from the plants which have been infected are planted.

The disease is manifested, as the name indicates, by a mottled appearance of the leaf. This mottling is usually not conspicuous, and often is not evident except when the plants are young. The leaves show areas lighter green in color as contrasted with other areas on the same leaves which are normal in color, and there is also usually a crinkling of the leaf. Figures 1 and 2, which contrast healthy and diseased plants, give a good idea of the general appearance of affected plants. While the effect on the plant in mild cases of mosaic is often not severe, the disease may increase from year to year

Let Us Spray

It is the only way to

save

Potatoes

from many of the diseases to
which they are heir.

*Read what the Potato Doctor
has to say.*

until extremely dwarfed and low-yielding plants are produced as is illustrated in Figure 3. Figure 4 shows the yield from the square rod illustrated in Figure 3, compared with the yield from a square rod of healthy Early Ohios.

The mosaic disease may not affect the yield greatly in Minnesota in cases in which the infection is mild. There are cases that have come to our attention in which practically every plant in a field of Triumphs showed mild mosaic, and yet the plants yielded at the rate of 300 bushels per acre. There is always danger, however, of the disease producing dwarfed, low-yielding plants even under the favorable conditions of northern Minnesota. When even the highest yielding strains of the Triumph variety which show the disease are sent into the South for seed, moreover, the disease seems to attack the resulting plants seriously, and the yield is greatly reduced. It is for this latter reason particularly that the importance of the disease is emphasized.

While the tubers from affected plants look perfectly normal except that they are often smaller, they nevertheless, carry the disease, and plants grown from these tubers show the mosaic. There is no known way of detecting the disease in the tubers, or of destroying the infection if present.

The disease probably spreads from plant to plant in the field by being carried by insects. The cause of the disease is apparently of the "virus" nature, and cannot be seen even with a microscope.

No cure is known for the disease. The prevention of mosaic is difficult. If seed could be saved from a field in which all the plants were free from the disease, healthy plants would result. Such fields of Bliss Triumph are apparently rare, either in Minnesota or elsewhere in the United States. It is unsatisfactory to attempt to select tubers from healthy plants in a field which shows much of the disease, since the apparently healthy



FIG. 1. MOSAIC AND HEALTHY EARLY OHIO. EARLY STAGE, JULY 9, 1919.

plants may have been infected by insects coming upon them from diseased plants. Efforts are being made to secure a stock of healthy Bliss Triumphs for Minnesota, and to guard against serious infection of other varieties.

Leaf roll (Figure 5) is a disease probably similar in nature to mosaic, but apparently not common in the state. The lower leaves particularly show a rolling, and are crisp in texture. The whole plant has an appearance often spoken of as "staring," and produces a small yield. The disease is transmitted by the use of seed tubers from affected plants.

Of the stem diseases, blackleg may be lessened by using healthy seed tubers, and by seed treatment or disinfection as

described below which is of value in sterilizing the surface of the potatoes before planting. The *Rhizoctonia* disease (dry stem rot) is avoided to a considerable extent also by disinfection, which kills the fungus which occurs on the tuber as black scurf. Wilt may be largely avoided by rotation of crops and the provision of good growing conditions for the plants, and also by clipping off the stem end of seed tubers which may harbor the fungus.

The potato tubers suffer from a number of diseases. Hollow heart often occurs when certain varieties of potatoes grow to a large size. This condition can be prevented by planting the potatoes somewhat more closely together, or by growing varieties not susceptible to this



FIG. 2. MOSAIC AND HEALTHY EARLY OHIO PLANTS LATER STAGE. PHOTO JULY 28, 1919

condition.

Black heart is brought about as a result of heat in storage or transportation, or sometimes through absence of air in storage. Net necrosis is rather rarely found.

Common scab and black scurf on the tuber can be killed by corrosive sublimate solution, as described below. Formaldehyde solution kills the scab germs on the tuber, but not black scurf. It must be remembered with both these diseases that the germs of the disease are often in the soil. Treatment of the tubers is, however, a sanitary measure which lessens the liability of attack by these diseases.

Powdery scab occurs sometimes in northeastern Minnesota; infected tubers should be "treated" as for common scab before being planted. Silver scurf is of very little importance in this state. Black wart is discussed in another article in this Annual.

Storage rots cause a very heavy loss annually to Minnesota growers and shippers. This loss is due to a considerable extent to the careless way in which potatoes are usually handled. In many bins it is hard to find tubers which are not bruised or injured in some manner. Too often potatoes are handled like cobblestones. A bruised or injured potato is very liable to rot, since the broken skin allows rotting organisms to enter.

Storage bins or cellars should be thoroughly cleaned out, and should be disinfected, before potatoes are put in. Provision should be made for ventilation. The storage should be cool, as near 35 degrees Fahrenheit as it is possible to keep it.

Bordeaux mixture is made at the rate of about 5 pounds of copper sulphate (blue stone), 5 pounds of stone lime, and 50 gallons of water. Dissolve the copper sulphate in 25 gallons of water by hanging it in a coarse sack so that it just dips into the water in a wooden barrel. Do not use metal for copper sulphate solution. Slake the lime, and add water

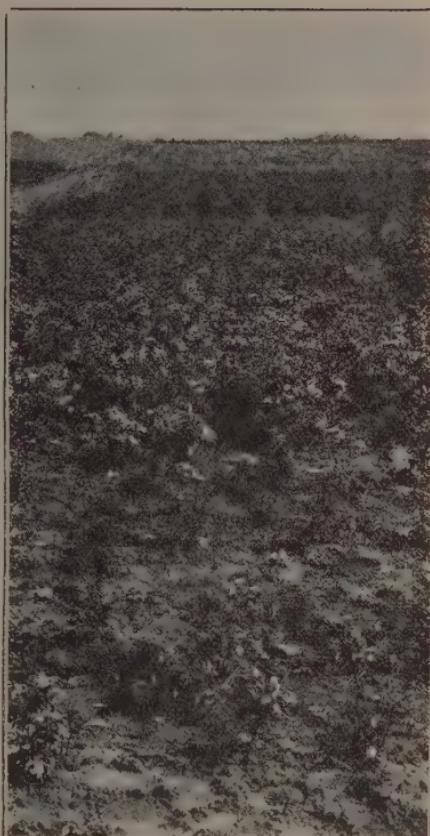


FIG. 3. LAST STAGE OF MOSAIC PHOTO JULY 9, 1919

to make 25 gallons. Mix the two by pouring them together, and spray at once after mixing.

If large fields are to be sprayed, make stock solutions by dissolving one pound of blue stone in each gallon of water, make the lime mixture at the rate of one pound of lime per gallon of water. These stock solutions keep indefinitely if the water is not allowed to evaporate. When spraying, mix at the rate of 5 gallons of each mixture and 40 gallons of water, thus making 50 gallons.

Corrosive sublimate solution is made from 4 ounces of sublimate to each 30 gallons of water. If smaller quantities are wanted use one ounce to $7\frac{1}{2}$ gallons of water, or in any proportion at the rate



FIG. 4. YIELD FROM 1 SQ. ROD OF MOSIAC PLANTS AND 1 SQ. ROD OF HEALTHY PLANTS.

of one part corrosive sublimate to 1,000 parts water. Soak the potatoes about $1\frac{1}{2}$ hours the first time used, $1\frac{3}{4}$ for the second lot of potatoes, 2 hours for the third and fourth lot, then throw the solution away and use a fresh lot of solution. Do not use metal containers, and remember that it is deadly poisonous.

Formaldehyde, if used, is made up at the rate of one pint to 30 gallons of water. For disinfecting bins, etc., about one pint to 10 gallons of water, or one pound copper sulphate to 10 gallons of water, is satisfactory.

Good agricultural practices, such as crop rotation, and selection, careful handling of the crop, etc., do much to lessen the damage from diseases. Many of these measures are discussed elsewhere in this publication. Vigorous strains of potatoes

should be grown, and all possible care taken to lessen the losses from diseases.



FIG. 5. LEAF ROLL. OBSERVE UPWARD ROLLING OF LEAVES.

THE POTATO WART DISEASE

J. J. CHRISTENSEN AND G. R. BISBY

Potato wart, which is usually considered the most serious and destructive disease attacking potatoes, has made its appearance in the United States. The disease is causing a very serious loss to potato growers and buyers in Ireland, England and other European countries. Losses in fields and gardens there often run as high as 50 to 80 per cent. It is not uncommon to have total failures due to this disease; in fact, there are places in Ireland and England where potato-growing has been given up as unprofitable due to this serious malady, known as potato wart.

History of the Disease

It is impossible to say where the disease originated. Potato wart was, however, described for the first time in 1896 by Schilberszky, of Hungary, but the disease was undoubtedly present some years before. As early as 1893 the disease was prevalent in England and it is believed to have existed in that country for at least forty years. Ireland reported the presence of potato wart in 1908, about the same time that it was reported in Scotland, Wales and Germany. One year later it was discovered in Newfoundland. In recent years the disease has made its appearance in Norway, Italy and France.

In 1910 the Federal Bureau of Plant Industry put out warnings as to the danger and seriousness of this disease. Attempts were at once made to establish an embargo against importation of potatoes from countries where potato wart was known to exist, but it was not until 1912 that such a quarantine was established. In the meantime over thirteen million bushels of potatoes had been imported.

In September, 1918, six years later, potato wart was discovered in Pennsylvania. After a thorough survey in the

*Warts
Destroy
Potatoes--*

from
50 to 80
per cent
sometimes
in
European
Countries

We do not want
them in
Minnesota

fall of 1918, by the United States Department of Agriculture, the wart disease was located in small gardens in twenty-seven towns and villages in Luzerne, Schuylkill and Carbon counties of Pennsylvania. The disease had evidently existed in these mining towns for a number of years as their potato crops had been ruined for three or four years previously. The people did not know the cause and attributed it to the soil and weather conditions. During 1919 new areas of infection have been found one hundred miles from those found last year. The disease also appeared in two localities in West Virginia.

Cause and Nature of Disease

The disease is caused by a parasite, one of the lower type of fungi (*Chrysophyct's endobiotica*). The organism gains entrance usually through the tender eyes of the tuber. The fungus may also attack the stolons or roots or that portion of the stem proper below the ground. After infection has taken place the organism stimulates the host cells, and there results a spongy, warty outgrowth, somewhat like a cauliflower in appearance. The size of these outgrowths may vary from that of a spongy, warty protuberance the size of a pea to that of a large cauliflower-like mass large as, or larger than, the tuber itself. In severe cases of infection the potato may be completely surrounded by warty masses, so that the tuber loses all its true characteristics. These outgrowths are at first whitish, but gradually become brown and as the potato matures they eventually turn black. The Potato Wart is easily recognized except in its early stages but the disease can not be detected until the potatoes are dug since the growth of the vines does not appear to be seriously affected.

Danger of Disease

As the potato matures the warts decay and secondary rot sets in; and often affected hills are a total loss or when infected tubers are stored, rot often claims a

Wage War on Warts!

Burn or boil all warty potatoes dug and warty parings.

Feed no warty potatoes to livestock unless they have been boiled.

Rotate potatoes with other crops.

Plant no potatoes in infected soil for at least ten years.

Grow no potatoes in or around infected areas. You must have a government license to do so.

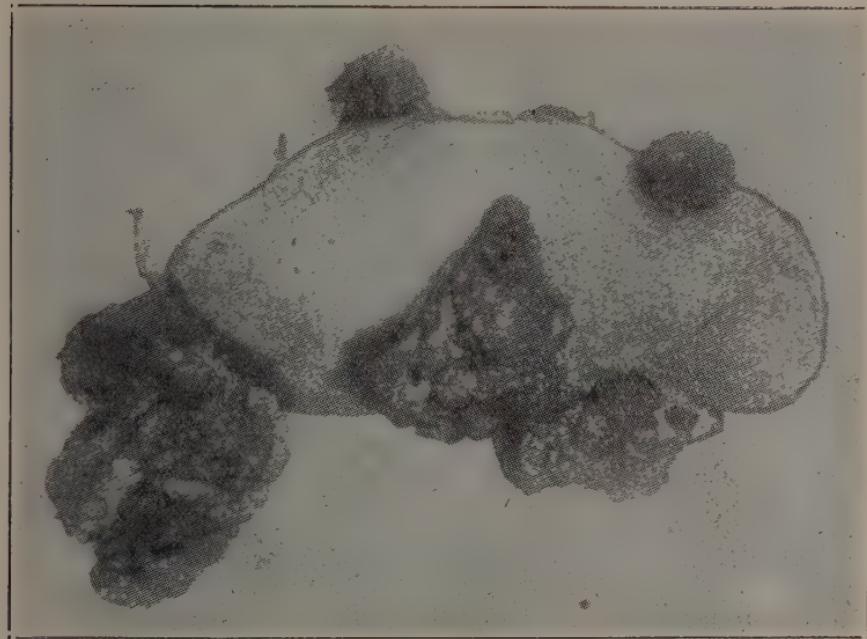


FIG. 1. WART ON POTATO TUBER

large percentage of tubers in a short time. Whenever these cauliflower-like protuberances decay millions of germs of the disease are released. These disease germs (spores) can live over winter in the soil; in fact, there is evidence that the buried spores in the soil, like seeds of certain higher plants, may remain inactive, but alive for eight years or more.

How Spread

Tubers may appear perfectly healthy yet they may harbor the fungus, if they have been grown in infected soil or have been in contact with warty potatoes while in storage. It is now believed that new localities are usually infected in this manner. Of course, the disease can be spread by planting diseased tubers. The disease can also be distributed by means of agricultural implements used to cultivate infected fields; by particles of dirt adhering to feet of men and animals; or by transferring small particles of earth along with root crops. If drainage conditions

are suitable the organism may be carried long distances by means of water. It has also been shown that the spores survive passage through the digestive tract of animals; so that if the diseased tubers are fed to animals without being boiled infection can take place through the use of manure. Peelings thrown in garbage may be a source of infection also.

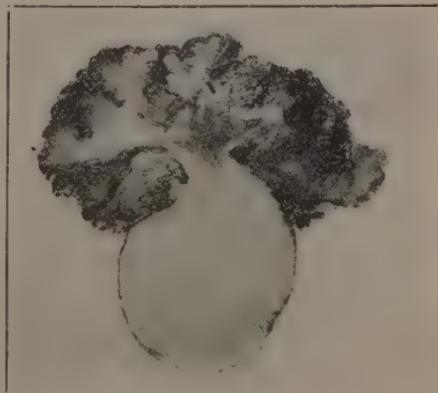


FIG. 2. CROSS SECTION THROUGH WARTY TUBER



FIG. 3. EFFECTS ON UNDERGROUND PARTS OF POTATO PLANTS. FIGURES 1, 2 AND 3 BY COURTESY OF THE PLANT DISEASE SURVEY OFFICE, U. S. D. A.

Prevention

1. All warty potatoes dug should be burned or boiled. The same holds true for parings.
2. Do not feed live stock warty potatoes unless they have been boiled.
3. Rotate with other crops. Do not plant potatoes on infected soil for at least ten years.
4. Some varieties seem to be resistant.
5. Strict quarantine (the growing of potatoes in and around infected areas is not permissible without a license issued by the federal government).

Survey in Minnesota

The United States Department of Agriculture fully realized the seriousness and destructiveness of this new disease. This led the Department to co-operate with the states in locating and stamping out this destructive disease of potato before it gained too strong a foothold.

In Minnesota the survey was undertaken in co-operation with the Plant Pathology Department. The chief aim of the survey was to reach as many people as possible. This was done chiefly by working through agricultural high school instructors, superintendents of schools and county agents, and also by means of publicity through newspapers and schools. It is needless to say that we received excellent co-operation from both the press and parties above named.

Between 400 and 450 gardens and fields were inspected and several thousand bushels of potatoes were inspected in the markets, warehouses and cars. Most of the inspection was carried on in the vicinity of the Twin Cities and mining regions of the state.

All county agents were first notified to be on the lookout. Sixty-five hundred poster-like cards were distributed to schools of Minnesota. To county agents, markets and others over thirty-five hundred of the cards were distributed making a total of over 10,000 cards.

Three hundred and twenty-five letters were sent to schools containing a prize offer together with a five hundred-word discussion of the disease. County agents were notified of the fifteen-dollar prize offer; some were sent articles of general discussions.

Twenty-six local newspaper articles were written up and published, and almost every paper in the state was reached through the Farm Press News, and notified of the danger of the Potato Wart and also of the prize offer.

Through the plant pathology division a reward of fifteen dollars was offered to the first boy or girl who reported the disease in Minnesota. This prize offer as already stated was published widely and a large number of schools were directly notified. As a result of this prize offer, specimens which were supposed to be affected with Potato Wart have been received from various parts of the state as illustrated herewith.

No evidence of Potato Wart was found, but this does not mean that the disease is not present; as it is impossible to reach everybody in a survey of one year. If all the people can be warned in regard to the seriousness of the disease so they may be on the lookout for it, it may be prevented from spreading. This will be much easier than trying to control the disease after it gets a foothold.

We should keep in mind the national importance of the potato crop and also the seriousness and destructiveness of the Potato Wart. Specialists of the United States Department of Agriculture say that if the disease should spread to commercial plantings it would cost the potato growers millions of dollars annually. If we keep these facts in mind the importance of being on the watch for this dangerous disease is obvious.

All suspicious specimens should be sent to county agents or Plant Pathology Department, University Farm, St. Paul, Minnesota.



FIG. 4. SPECIMENS SENT IN BY CHILDREN

The above specimens were sent in principally during October, 1919, suspected of being affected with wart. These tubers were affected as follows:

Common scab only.....	30
Black scurf and scab.....	6
Scab and secondary rot.....	8
Scab and wire worm injury, etc.....	20
"Knobs" and scab.....	10
Knobs only (see upper tuber).....	2
Beets with common scab.....	2
Rutabagas and turnips with club root.....	3
(Observe resemblance to wart disease)	
Total specimens (exclusive of portions of potatoes).....	81

POTATO WARTS

are *not* knobs on potatoes; they *are* spongy outgrowths, looking something like a small cauliflowers.

LOOK OUT FOR THEM !!!

POTATO INSECTS

A. G. RUGGLES AND S. A. GRAHAM

The commonest and most generally known insect attacking the potato is the Colorado potato beetle. Although in many sections this is apparently the most injurious insect attacking the crop, it is by no means the only one. The potato is subject to the attack of insects from the time of planting until it is served on the table. The seed pieces when planted are sometimes injured by the burrowing larvae of a fly and are often attacked and partially or wholly destroyed by wireworms, cutworms, or white grubs. The young plants are often attacked and destroyed by cutworms and the leaves are injured by Colorado potato beetles, blister beetles, flea beetles, leaf-hoppers, plant bugs, aphids, and several others of lesser

importance. Fly, moth, and beetle larvae often are found boring in the stalk. The roots and ripening tubers are injured by flea beetles, wireworms, and white grubs, and finally the tubers in storage are sometimes injured by fly larvae, wireworms, or other tuber-feeding insects brought in from the field. Approximately one hundred species of insects are known to attack the potato in one stage or another, but fortunately a large proportion of them are not sufficiently numerous or destructive to be of primary importance. Pests attacking the upper parts of the plants are most commonly observed, but those attacking the underground parts are often as injurious and are much more difficult to control.



FIG. 19. COLORADO POTATO BEETLE AND LARVAE FEEDING (FROM CHITTENDEN)

The Potato's Life is One Damned Bug After Another

Many species of insects are in league against the potato. Potato growers should form a league of war against them. Use heavy artillery.



COLORADO POTATO BEETLE*Leptinotarsa decemlineata* Say**Order—Coleoptera Family—****Chrysomelidae**

The Colorado potato beetle is frequently and improperly called the "potato bug." The adult beetle is about two-fifths of an inch long and a little more than half as broad. The wing covers are marked with ten longitudinal black stripes on a yellowish brown background and the thorax is somewhat spotted with black. The larvae are red soft-bodied creatures with black heads and a double row of black spots along the sides, and are often called "slugs."

Life History

The winter is passed in the adult stage in the ground. About the time the potatoes are up these adults make their appearance and, after feeding for some time upon the leaves and stems, lay their yellow or orange eggs in clusters of from ten to fifty on the under side of the leaves. In from four to eight days these eggs hatch and the larvae feed on the leaves and grow rapidly. In from nine days to two weeks they reach their full growth, leave the plants, and go into the soil for the pupal or resting stage, which lasts from ten days to two weeks. Following the pupal stage they transform to the adult stage and again appear on the potatoes. The fecundity of the beetle is high, single females being known to lay from 1,500 to 4,000 eggs during a period of two months, so the importance of controlling the first brood is evident. In Minnesota there are two generations each season.

Natural Enemies

The Colorado potato beetle is subject to the attacks of several natural enemies, but in most seasons these are not in sufficient numbers to hold the beetles in check. The most important of these enemies are the ladybird beetles and the larvae of the lacewing flies which attack the potato beetle, eggs and "slugs." A few wild birds destroy the larvae of the

potato beetle, the rose-breasted grosbeak being the species most commonly observed. Some domestic fowls, particularly the guinea, turkey, and duck, when allowed to run in the potato fields, are valuable in cleaning the plants of "bugs."

Control

The most certain method of controlling the potato beetle, and the one usually depended on in potato-growing sections, is the treating of the plants with an arsenical spray. Bordeaux mixture, as a fungicide, is frequently mixed with the arsenical spray. The material which has been most commonly used in the past is Paris Green, which is an effective poison for the beetle when used at the rate of one pound to 50 gallons of water or Bordeaux mixture. For the first spraying one pound should cover about one acre. Arsenate of lead is not so strong a poison as Paris Green, but owing to its sticking power it has been recommended and has proved satisfactory when used at the rate of from 1½ to 2 pounds of the powder to 50 gallons of water. The secret of success in using arsenate of lead against the potato beetle is to get the material on the vines early since the young "slugs" are much more susceptible to poisons than those which are fully grown. Put on the first spray as soon as the eggs begin to hatch and repeat as often as necessary.

THE POTATO FLEA BEETLE*Epitrix cucumeris* Harr**Order—Coleoptera Family—****Chrysomelidae**

Although the potato flea beetle has been an important pest in the Eastern states for many years, it has been practically unknown in Minnesota until recently. Last summer this insect was responsible for considerable injury in limited areas, but it bids fair to establish itself and become one of the pests which must be fought each year.

The beetles are about one-twelfth of an inch in length, black, somewhat hairy, and have the hind legs well developed for

Potatoes Have Fleas

The flea beetle,
a potato pest
from the east,
has invaded the
North Star state.

*It can be repelled by the use of
Bordeaux Mixture*



FIG. 20. TUBER INJURED BY LARVAE OR POTATO FLEA BEETLE. (FROM WEBSTER.)



FIG. 21. ADULT POTATO FLEA BEETLE ENLARGED 24 TIMES. (FROM WEBSTER.)

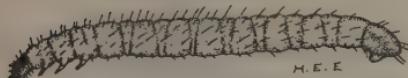


FIG. 22. LARVA OF POTATO FLEA BEETLE ENLARGED 20 TIMES. (FROM WEBSTER.)

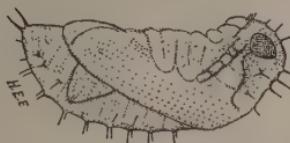


FIG. 23. PUPA OF POTATO FLEA BEETLE ENLARGED 30 TIMES. (FROM WEBSTER.)

THE POTATO FLEA BEETLE

jumping. It is this habit of leaping away when disturbed that gives the insect its common name.

Life History

Flea beetles pass the winter in the adult stage, hidden away beneath leaves or other litter. In the spring the adults leave their hiding places and as soon as the potatoes are up begin to feed upon the leaves, usually from the under side. They eat almost through the leaf from below, leaving the upper epidermis untouched. Later this usually dries and drops out, making a hole through the leaf. This injury to the leaves is usually the first indication of an infestation, since the beetles themselves are seldom noticed.

The eggs are laid singly in the soil and the larvae, which are tiny, elongate, and worm-like in form, attack the roots and finally burrow into the developing tuber, causing pimply potatoes. When full grown the larvae transform to the pupal stage and in midsummer emerge as adults.

There is apparently but one generation a year.

Control

The flea beetle is a much more difficult insect to control than the Colorado potato beetle owing not only to the fact that it is resistant to poisons, but also to the habit of feeding on the lower surface of the leaves, making it difficult to put the poison on the foliage where it will be eaten. So far as our knowledge goes, good results cannot be expected from stomach poisons.

The material which has given the best results in the Eastern states is Bordeaux mixture, which has a repellent effect upon the beetle. When the plants were well covered by the spray the results were very satisfactory, but when the material was applied unevenly and the under sides of the leaves were not sprayed, little deterrent effect was noticeable. Bordeaux mixture has given very imperfect control of the flea beetle in Minnesota, owing per-

haps to the fact that the type of sprayer commonly used in this state sprays the plants only from above. If the nozzles were so arranged as to drive the spray in from the sides, much better results could be obtained in the control of both insects and disease. Such machines are on the market but are seldom seen in this state.

THE APPLE LEAF-HOPPER

Empoasca mali Le Baron

Order—Hemiptera Family—Jassidae

The apple leaf-hopper is usually considered a pest of apples, but it also attacks many field and truck crops and is particularly injurious to potatoes. The leaf-hoppers are sucking insects, i. e., they do not eat the leaves, as do Colorado potato beetles, but feed on the juices of the plant by inserting their proboscis into the tissues of the leaf or stem and sucking the sap. The evidences of injury are usually slight, and consist of a curling of the injured leaves and more or less dwarfing of the plant except in dry seasons, when the tips are often killed. The real injury is the reduction of the crop due to the stunting of the plants caused by the loss of sap.

The adult hoppers are small, pale green insects, about one-eighth of an inch long. The wings fold over the back like the sides of a tent. The nymphs, or immature forms, are wingless. Both the nymphs and adults are very active and jump or fly away quickly when disturbed, the adults being much more active than the nymphs.

Life History

Leaf-hoppers usually pass the winter in the adult stage, hidden beneath leaves or other trash. They do not usually make their appearance on the potatoes until late June, when the adults lay eggs in the stems. These eggs hatch and the wingless nymphs suck the juices of the plants and in about a month reach maturity. There are probably only two generations a year, although there may be a partial third. The hoppers may be found on the potatoes

as long as the plants are green in the fall. Two or more other closely related hoppers with slightly different life histories may occur on potatoes with the apple leaf-hopper and complicate control measures.

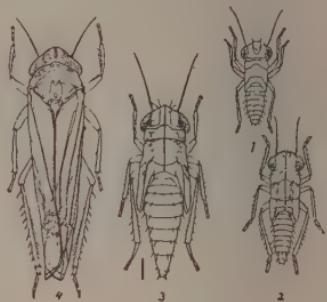


FIG. 24. LEAF HOPPER, ADULT AND NYMPHS.
(FROM WASHBURN)

Control

Like that of the flea beetle, the control of the leaf-hopper is still in the experimental stage, owing largely to the fact that they have only recently come to be regarded as very injurious to potatoes. Their habit of feeding precludes any possibility of success with arsenicals or other stomach poisons and their rapid movements make them difficult to hit with a contact spray. The contact spray, however, is the best measure that can be suggested at present. When the spray is applied at the time most of the hoppers are in the wingless stage, fair results have been obtained. The proper time for spraying will vary with the season, but will usually come about the middle of July. The best material for this spraying is a tobacco extract to which at least one pound of soap has been added for every 50 gallons of liquid. A free nicotine extract such as "Nicofume" is better than the extracts such as "Black Leaf 40," containing nicotine sulphate. As these commercial tobacco extracts are standardized, they are much to be preferred to the home-made products. The usual dilution for a 40 per cent nicotine extract is one-half pint to 50 gallons of water, to

which at least one pound of soap has been added. Soft liquid or fish oil soaps are, as a rule, much more effective for this purpose than the hard soaps. These nicotine extracts can be used at double this strength without danger of injury to the plants. Do not mix Bordeaux mixture with the nicotine spray or the value of the spray as a contact insecticide will be much reduced. In spraying with a contact insecticide it should be remembered that the insects must be hit by the spray if the treatment is to be successful. Although widely recommended as a contact insecticide, recent investigations have shown that kerosene is so variable in composition as to make its use undesirable.

THE POTATO APHID

Macrosiphum solanifolii Ashm

Order—Hemiptera Family—

Aphididae

Another insect which in some seasons causes considerable loss to potato growers and every year causes some injury is the potato aphid, or plant louse. The aphids, like the leaf-hoppers, are sucking insects and do not eat the leaves, therefore, their injury has an effect upon the plants similar to that caused by the leaf-hopper.

Life History

The potato aphids pass the winter in the egg stage, usually on some plant other than the potato, the rose being a favorite. In the spring the eggs hatch and the young aphids feed and multiply on the plant on which the eggs were laid. In late June or July they migrate to the potato, where they spend the remainder of the summer. In the fall they scatter to other food plants, although some will remain on the potatoes as long as the plants are green. On the potato plants the aphids reproduce rapidly, a single female giving birth to more than fifty young in two weeks. The young begin to reproduce two weeks after birth, which explains the sudden appearance of some infestations.

Natural Enemies

It is only the extreme fecundity of the aphids which makes it possible for them to survive the attacks of their enemies and remain a serious pest. They are attacked by the larvae of the ladybird beetles, the syrphids, and the lacewing flies, as well as by several tiny wasp-like parasites.

Control

The Colorado potato beetle, the potato flea beetle, the apple leaf-hopper, and the potato aphis are the most universally injurious potato insects, but occasionally there are outbreaks of other less common pests. These will be briefly discussed and the best methods recommended to date for their control will be given.

OTHER POTATO INSECTS

Frequently the natural enemies of the aphids will keep the pest in check, but this is not always the case. When artificial methods of control are necessary the use of a nicotine and soap spray as mentioned for leaf-hoppers is the best remedy. This material should be applied thoroughly so as to hit the aphids. A sprayer which throws the spray in from the sides is much better than a machine which sprays only from above.

BLISTER BEETLE OR "OLD-FASHIONED POTATO BUG"

Epicauta pennsylvanica DeG

Occasionally slender gray or black beetles, from one-third to one-half an inch in length, with soft wing covers, will attack and sometimes strip a field of potatoes. These are blister beetles and can be controlled by using arsenate of lead as for the Colorado potato beetles. The larvae of these insects are beneficial, living on the eggs of grasshoppers.

PLANT BUGS

Several plant bugs attack and injure the potato by sucking the juices in much the same manner as the leaf-hoppers.



FIG. 26. POTATO SHOOT INFESTED WITH POTATO APHIDS (FROM PATCH.)



FIG. 27. LADYBIRD BEETLES a. LARVA d. PUPA e. ADULT (FROM RILEY.)

If they threaten to become abundant, the application of a tobacco and soap spray, applied when the nymphs are in abundance, should keep them within bounds.

These can only be controlled by cutting out and destroying the infested stalk and by keeping down weeds, particularly ground cherry and burdock, in and around the potato field.



FIG. 28. LACEWING FLY. a. LARVA c. AND d. PUPA g. EGGS ON LEAF h. SINGLE EGG AND STALK MUCH ENLARGED (FROM LUGGER.)

CABBAGE LOOPER

Autographa brassicae Riley

Occasionally there is found in potato fields a small green measuring worm which may vary considerably in shade, the darker being usually marked with longitudinal white lines. This is the cabbage looper, and may do considerable damage in unsprayed fields, but can easily be controlled with an arsenical spray.

STALK BORER

Several insects bore into the potato stalks, injuring or killing the vines.

WHITE GRUB

White grubs are the larvae of the May beetles and are among the most injurious of the subterranean insects. They feed upon the roots of grasses and other plants and frequently attack the roots and tubers of the potato. Since the eggs are usually laid in grass land they are likely to be most injurious when potatoes are planted on sod. In Minnesota the most common white grubs require three years for the completion of their life cycle and as they increase in size their powers of destruction also increase. The adult beetles were out and laying eggs last year (1917) and since the majority of beetles appear in cycles of three years, this season (1918) is a moderately bad white grub year and next year will probably be still worse, so that potatoes should follow some cultivated crop wherever possible. If it is necessary to plant on sod land, the ground should be plowed and disced in the early fall preceding planting and hogs turned into the field to pick up the grubs.

WIREWORM

Another group of subterranean insects which normally feed on the roots of grasses, but which also attack the potato roots and tubers, is the wireworms. These are the larvae of click beetles and are slender and worm-like in form, with a hard body covering from which the name is derived. The greatest injury caused by this insect is the scarring of the surface and the boring into the tuber. If potatoes in which wireworms are working are put in the bin, the worms will continue to work through the winter, and going from one potato to another may cause great loss. Do not follow sod with potatoes and do not store potatoes infested with wireworms.



FIG. 29. "OLD-FASHIONED POTATO BUG" OR BLISTER BEETLE (FROM WASHBURN.)



FIG. 30. BLISTER BEETLE LARVA IS GRASSHOPPER EGG CAPSULE (FROM WASHBURN.)



FIG. 31. TARNISHED PLANT BUG a. ADULT b. NYMPH (FROM LUGGER.)



FIG. 32. INJURY TO POTATO LEAVES BY TARNISHED PLANT BUG

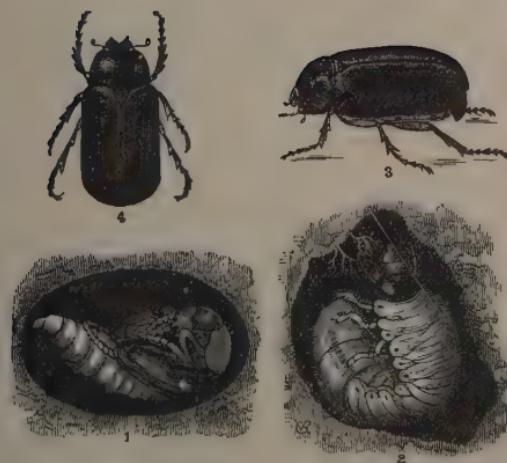


FIG. 33. WHITE GRUBS 1. PUPA 2. LARVA 3 AND 4. ADULTS (FROM RILEY.)

Wire Worms

Like to

Eat Your Potatoes

In Winter

*Don't Store Potatoes
Infested with the Pests*



FIG. 34. WHITE GRUB WORM WORKING IN A POTATO TUBER (FROM DAVIS.)



FIG. 35. WIRE WORMS, LARVAE OF CLICK BEETLE (FROM WILLIAMSON.)



FIG. 36. CLICK BEETLE, ADULT OF WIRE WORM. (FROM FORBES.)



EGGS OF STALK BORER



FIG. 37c.



FIG. 37b.



FIG. 37d.

FIG. 37. ONE OF THE STALK BORERS a, EGGS b, ADULT c, LARVA d, PUPA

GENERAL RULES FOR SPRAYING POTATOES

1. For leaf-eating insects, use a stomach poison, either Paris Green, or arsenate of lead, the latter being preferable. Poison while the larvae are small.

2. It is advisable to mix the fungicide Bordeaux mixture with the arsenical sprays and apply at the same time.

3. For sucking insects, use a contact insecticide, the best being a commercial nicotine solution to which has been added at least 2 pounds of soap to each 50 gallons of the material diluted for spraying. An extract such as "Nicotume," which contains free nicotine, is better than solutions containing nicotine sulphate, such as "Black Leaf 40." A 40% extract should be diluted at the rate of one-half

pint to 50 gallons. The addition of soap is important.

4. Do not mix Bordeaux mixture with nicotine sprays as the insecticidal value will be reduced.

5. For leaf-hoppers and plant bugs, spray with nicotine and soap when the nymphs are in the greatest abundance.

6. Apply sprays thoroughly to all parts of the vine, particularly where a contact insecticide or a repellent is used. This may necessitate the remodeling of the old spray boom, which can be successfully done for a small outlay, provided the machine has sufficient surplus power to carry the extra nozzles, or it may mean the purchase of a machine with the nozzles so arranged as to drive in the spray from the sides as well as from above.

POTATO CONTESTS AND EXHIBITIONS

W. J. CORWIN, HINCKLEY, MINNESOTA.

Potato shows and contests are two of the greatest factors to stimulate standardization of varieties, better treatment and care of seed, better cultural practices and general improvement of marketing conditions—in fact, everything that tends to increase the net returns to the farmer in the sections of the country where potatoes are one of the main cash crops.

State and National shows, County potato shows and Community shows are all important factors in the improvement of the potato industry, but in our opinion the county and community shows really get the ideas over to actual farmers in a very efficient manner. During seven years of the writer's work in northern Minnesota, a large number of community potato shows have been held, and this year the second annual county show for Pine County was held.

Development Through Exhibits

Shows have been one of the most effective means of extension work for potato improvement that we have ever

tried. At first there seemed to be a very poor if any understanding of variety type. At many of the first local shows very large, coarse, overgrown tubers were displayed. While the writer was judging at a small fair in the Bigfork country of Itasca County one man remarked, "Why don't he look at these potatoes." We cut the large, coarse, tubers and let the water out of the immature center. He was satisfied.

For the first time these men had pointed out to them the Green Mountain type and quality to select. Their show next year lacked the big, coarse specimens, possessed more quality and the exhibitors had learned their first lesson. At Warba, Blackberry, Cohasset, Bear River, and other points the writer had the same experience that year. But it was the beginning of a change. Better type, better quality, fewer diseased specimens were displayed and more enthusiasm developed.

The county show also demonstrated remarkable strides in this direction and

Why Have a Potato Show?

Because—

POTATO shows mean the growing of more and better potatoes.

MORE and better potatoes mean more prosperity.

Read what Corwin says!



GENERAL VIEW OF GRAND RAPIDS SHOW

last year Itasca County's exhibit easily won first in the state show. But more important than that is the fact that to-day seed treatment, better cultural methods, and rotations are quite general among the farmers of Itasca County.

Results in Pine County

About two years ago the writer became agent in Pine County. A potato campaign for standardization of varieties was put on, local shows were held last fall and the first all-county exhibit for potatoes only, was held at Hinckley. While these first shows were small, very creditable beginnings were made. The same as in Itasca County, great interest became manifest in types and varieties, diseases and their control, marketing problems and cultural practices.

Local shows at the same points this year demonstrated wonderful improvement. In just one year the entries doubled; the number of varieties decreased; the quality and type shown was a decided improvement and at Askov only one variety, the Green Mountain, was on exhibition.

Pine County's second annual show was

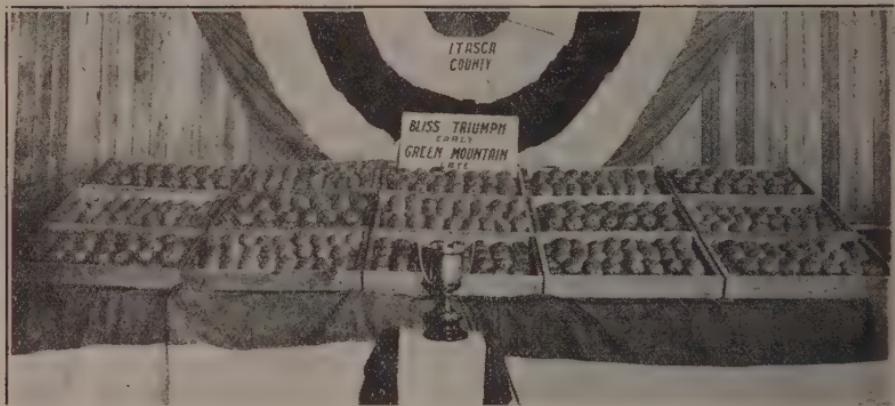
held at Hinckley October 18, 1919. An enthusiastic crowd was drawn in from nearly all parts of the county. The number and quality of exhibits more than doubled that of last year. The interest taken in potato improvement, standardization and marketing problems more than justifies the effort of the Farm Bureau Organization in its campaign for bigger returns on this main cash crop.

Varieties Limited

Green Mountains were more than half the show, though five other varieties had a small representation. One of the valuable features of the show was the tuber unit exhibit from three of the fifty or sixty farmers who have been working in co-operation with the County Agent on seed improvement. These men exhibited the total product of single potatoes. Some yielded five times as much as other equally good looking tubers that were grown on the same soil by the same man.

Better Type

There was also a difference in trueness to type and percentage of inferior stock. For the last two years these exhibits at



FRIST PRIZE COUNTY EXHIBIT GRAND RAPIDS SHOW

the county show have proved that to secure desirable improvement and best returns systematic selection of seed by means of a seed plot is essential and that such selection should not be based on type alone, on larger yield alone, or on freedom from disease alone, but rather, on the best combination of good yield, healthy vigorous stock, low percentage of small and undesirable tubers, and good type. In other words, selection based on only one of the above points will lead to failure and disappointment, while selection based on the best combination of the above points leads to success in the potato game.

At these local and county shows the actual raisers are present, the judge and

other experts lead in potato discussions, a large display of excellent type and quality encourages the farmers to become up-to-date potato raisers. This spring requests for information on seed treatment were four times as numerous as the previous year. Seventy-five farmers have seed plots this year as compared with only three last year.

These results come mainly from the enthusiasm spread at the local and county shows. Let's have more of them! They stimulate bigger and better state shows and, better still, they get to the hearts of the actual growers. Through these shows the way is opened for standardization of varieties, better market quality and more net returns.

POTATO EXHIBITIONS

T. M. McCALL

The primary object of the potato show should be educational. The chief aim should be to improve the quality of the product produced and for that reason the show should offer prizes which are an incentive to new or amateur exhibitors to compete. In most community shows the number of exhibitors generally decreases as the years go by even though extra liberal prizes may be offered. The same falling away in the number is seen in many of the county, district, and even in state fairs. The chief excuse given by most growers for not exhibiting more than once generally runs like this: "Well, I sent up a sample once to the show but it is no use for me to try to show against Sam Jones and Bill Smith and that bunch for they are old experienced hands at the business." In practically every community the few professionals scare out the amateur and in a few years the show instead of being a great educational force in the development of the industry becomes a mad race for the coveted honors by a few individuals.

Provide Professional and Amateur Classes

It seems to the writer that professional growers and professional exhibits should be encouraged for but few have reached perfection, but the amateur should be given the greatest encouragement for by so doing the standard of quality of the community product is raised. An exhibitor should be called a professional as soon as he becomes a first prize winner in a variety against competition. The degree of perfection required for a sample to be given first prize would naturally vary in different shows and with different judges, however, a sample to put a man in the professional class should be true to type for the variety, reasonably clean and free from noxious diseases. In the potato show an exhibitor winning first in Early

H I G H
Quality

The
Right Slogan
For
EVERY
POTATO
SHOW

H I G H
Quality
That's it!

Prizes for Amateurs

They should be offered at EVERY potato show.

Otherwise the show will become merely a contest for "PROFESSIONALS."

Potato shows, therefore, should provide for two Classes—

PROFESSIONALS
AMATEURS

Professionals to be those who have won a first; amateurs those who have not.

Ohio should not be put in the professional class in another variety until after he has won first place in that variety. An amateur would be classed as an exhibitor who has not won first prize in a given variety.

Prizes offered amateurs should be liberal enough to pay for the expense of showing if possible and the first prize in each variety should be something worth while. Cash or other prizes may be offered for the professional exhibitors, however the silver loving cup, the gilt edged banner, or the gilt lettered prize ribbons should suffice. Prize winners from the amateur and professional classes should compete for grand champion sweepstakes, which competition keeps the rivalry at a high pitch.

Selection of Potatoes for Exhibit

"High quality" should be the slogan for every potato show. Exhibitors should take greatest pains to see that their exhibits are in the best possible show condition. To secure the show finish to an exhibit several rules should be followed in its preparation, some of the more important of which are: (1) Dig potatoes when mature and when the tubers come out clean, and never wash potatoes. If they are dirty, brush with a soft brush. (2) Select potatoes from the best part of the field and dig by hand if necessary to prevent skin injury. (3) Select only tubers of good type for the variety, all of uniform type and size (7 to 8 ounces for the early varieties, 8 to 10 ounces for late sorts). (4) Select tubers free from scab, black scurf, stem rot, and other diseases. (5) Handle potatoes carefully, wrap separately in paper, put in baskets or boxes and store in a dark, dry, cool place until needed. It is a safe plan to select more potatoes than those required for the sample to provide for any loss that might occur in storage. If there is question as to the proper type for the variety, full

information can generally be obtained from the nearest experiment station.

One striking feature of many of the smaller potato shows is the lack of standardization in both quantity and quality of exhibits shown. Where peck samples are called for many samples fail to fill the allotted space, while many others overflow the space and in a haphazard manner; such samples show at a great disadvantage as compared to the neatly arranged sample of the right size. It must be kept in mind by all concerned that potato exhibitions are not conducted solely that the producer might learn how to achieve perfection but exhibitions are conducted also as legitimate means of advertising and popularizing the crop. For this reason potato growers should take pride not only in selecting the sample but also seeing that the sample conforms to the requirements of the show in every respect. In this utilitarian age the large potatoes do not appeal to the practical housewives, but the samples in which the individual tubers are all clean, bright, and smiling and all as near alike as peas in a pod not only appeal to the housewife but to the seed merchant and consuming public in general.

Placing Exhibits

The placing of the exhibits is the final factor which will make or break up a show. It is needless to say that competent judges should be secured to make the show live up to its educational possibilities. The judge should know the varieties placed and the approved type of each. After the varieties are placed they should be arranged in order of placing so the exhibitors and the public can compare the samples. Reasons should be given by the judges so the exhibitors can profit by their experiences and be inspired to come back in the show the following years. A charitable spirit on the part of the exhibitors, judges and management makes for a successful show.

EXHIBIT BOXES FOR POTATOES

R. S. MACKINTOSH



Neat and uniform boxes that may be easily moved from place to place should be provided for all potato exhibits as well as for exhibits of threshed grains and small vegetables. Exhibits to be of any educational value must be displayed in good form. At the Minnesota State Fair and at some of the county fairs those in charge have adopted an excellent exhibit box that is light in weight, reasonably strong, capable of being nested to save storage space, and of such shape that the contents show off to best advantage. Boxes that can be moved about make it easier for the judge to place the samples in proper order. All fair associations should supply exhibit equipment for

such equipment is just as important as race tracks and good buildings.

The shape of these boxes makes them easy to handle and allows more of the contents to be seen when full, or only partly full, than in a box with perpendicular sides. The boxes are made of three-eighths or one-half inch lumber.

Sizes			
Capacity	Top Inches	Bottom Inches	Depth Inches
1 Peck	9 3/4 x 11 1/4	7 1/2 x 9 1/4	5
1/2 Peck	7 1/2 x 9 1/4	5 3/4 x 7 3/4	4
2 Quart	6 x 7	4 1/4 x 5 1/4	3 3/4

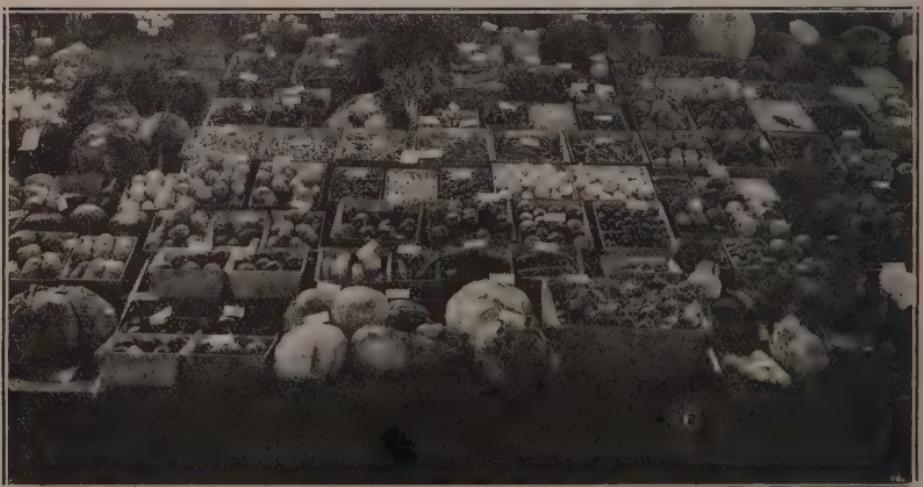


EXHIBIT BOXES IN USE

USES OF POTATOES

ADELE KOCH

Potatoes are extensively used as food because they are plentiful and cheap, and also because they are easy to prepare. Next to bread, they are probably our most extensively used food. In most homes, potatoes appear always once a day, and usually two times a day. The average quantity used by each individual in the United States is about four bushels a year. Because they are mild in flavor, we do not tire of them.

Although convenience in obtaining potatoes and the ease of preparation are two good reasons for putting them on the menu frequently, the housewife will use them to even greater advantage if she appreciates their nutritive value and the advantages to be gained by using a few different methods of preparation.

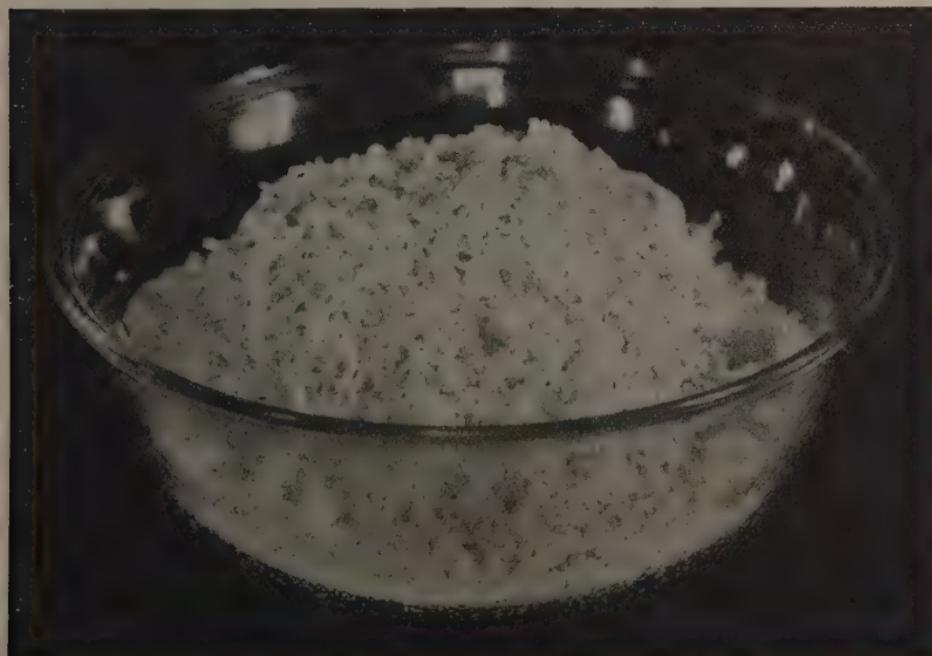
To easily determine the place of potatoes in our daily food, it is well to know what the daily food must mean to the

family. The nutritive needs of the family consist of energy needs, building needs, upkeep and repair needs, and of course, hunger and appetite must be appeased.

The greater part of the daily food is used to supply energy and fortunately the foods which do this most efficiently are potatoes and cereals. It is well that our energy yielding foods are our cheapest foods, because they are eaten in the largest quantities.

The composition of potatoes is three-fourths water, about one-fourth starch—there is about eight times as much starch as protein—a little fiber, a very little fat and an amount of ash which is large, compared with other foods. So they easily fall into the class of energy yielding food, and also that of repair and upkeep.

During the war we tried to use potatoes as a substitute for bread, and for a short time this could be done; but potatoes are



RICED POTATO



STUFFED BAKED POTATO

much better used to supplement bread on the table.

It is not enough for the housewife to know that certain types of food are valuable and to undertake to use these types. She should know how to prepare them appetizingly and in tasteful combinations.

Because potatoes are mild in flavor they allow for combinations with many other foods. Meat and potatoes are so common a combination as to be an invariable rule in all households and hotels. To most women it never occurs that there are other ways of cooking potatoes than to boil, mash, bake or fry. She is not even very particular whether she boils them or bakes them, deciding this more by the time of day the meal is prepared than by the menu itself. For instance, it seems inevitable that for breakfast she serves creamed potatoes; for dinner, baked, boiled or mashed, and for supper, fried.

Another method of combination would seem more effective, more appetizing and teach a wise discrimination in food selection that ought naturally to follow since we eat so often and so much.

Whenever meat is broiled—broiled steak, lamb chops or whenever the protein basis of the meal is served without a

sauce or gravy, it is a good plan to serve the potatoes creamed or mashed.

With a meat loaf, meat croquettes, or croquettes of any kind, the potatoes should be baked or boiled or served in some way which leaves them in good sized pieces, of a consistency which differs from the meat served.

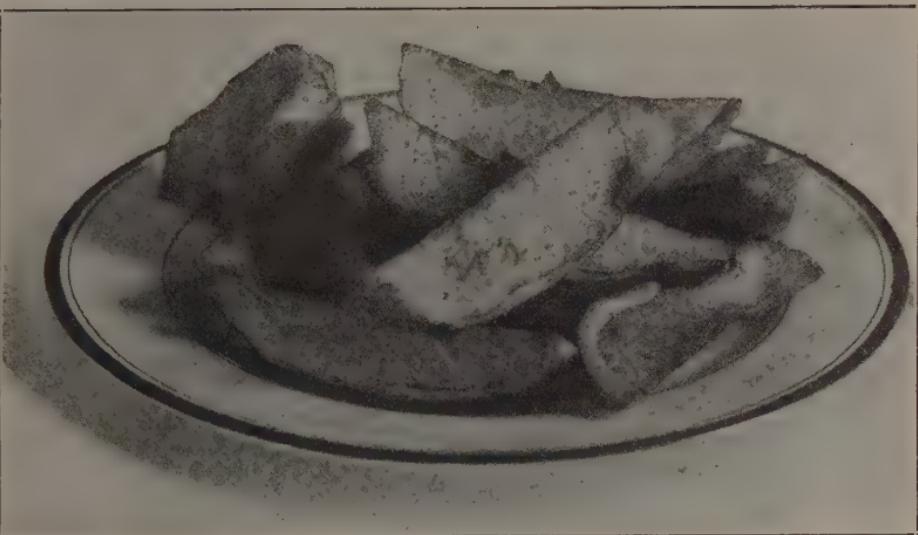
There are many ways of preparing potatoes and also of using leftover potatoes and a few recipes are added as suggestions:

French Fried Potatoes

Wash and pare medium sized potatoes, cut in eighths lengthwise, and soak in cold water one-half hour; drain, dry and fry in deep fat about seven minutes; drain on soft paper, and sprinkle with salt. The fat should brown a piece of stale bread in one minute—it is then the right temperature for cooking raw foods.

Hashed Brown Potatoes

Melt in the frying pan four tablespoons sausage fat, beef drippings, or other fat, add two cups chopped boiled potatoes, season, and cook slowly twenty minutes, or until well browned; fold double and garnish with parsley.



FRENCH FRIED POTATOES

Pan-Roasted Potatoes

Prepare potatoes as for boiling, boil ten minutes, drain and cook in roasting pan with meat about 40 minutes, baste often with fat in pan.

Scalloped Potatoes with Cheese

Wash and pare four potatoes, cut in very thin slices, put half of them in a greased baking dish, dredge with flour, sprinkle with salt, pepper, and two tablespoons grated cheese; repeat; cover with hot milk and bake in a moderate oven one hour or until potatoes are tender.

Scalloped Potatoes with Peppers and

Cheese

1 quart half-inch potato cubes.	rika.
1 onion chopped.	2 canned red peppers or fresh green sweet peppers.
2 tablespoons bacon fat.	$\frac{1}{2}$ cup grated cheese.
4 tablespoons flour.	$\frac{1}{2}$ cup buttered crumbs.
2 cups hot milk.	
$\frac{1}{2}$ teaspoon salt.	
$\frac{1}{2}$ teaspoon pap-	

Cook potatoes and onion in boiling salted water twenty minutes, and drain; melt bacon fat, add flour, and blend well; add milk and stir until smooth; add salt, paprika, peppers chopped, and cheese; mix with potatoes, turn into a greased baking dish, cover with buttered crumbs and bake fifteen minutes or until brown.

To butter crumbs melt two tablespoons of butter, stir in one-half cup of coarse, dried bread crumbs until butter is absorbed.

Potato Souffle

Hot mashed potatoes, 2 cups.	Butter, 1 table-spoon.
Milk, $\frac{1}{2}$ cup.	Chopped parsley, 1 tablespoon.
Eggs, 4 (whites only).	Salt and pepper.

Season the potatoes with butter, salt, pepper, and parsley. Then beat in the milk and stir the mixture until it is smooth. Stir in the beaten whites of the eggs, then turn it into a buttered dish, and bake for about ten minutes. Serve immediately or it will fall. Grated cheese is sometimes sprinkled on the top just before serving.

Glazed Sweet Potatoes

Boil sweet potatoes until done. Peel. Cut into halves lengthwise. Brush potatoes with melted butter. Put into buttered baking dish. Baste at once with molasses, and bake until brown. Continue to baste while the potatoes are baking.

Sweet Potatoes and Apples

8 sweet potatoes.	$\frac{3}{4}$ cup sugar.
	1 cup syrup.
8 small apples.	1 tablespoon butter.
1 cup water.	

Cook the potatoes with skins on for about fifteen minutes until they begin to be tender. The potatoes should not be thoroughly done. Slice in pieces about one-half inch thick and place in roasting or baking pan with apples which have been

washed and cored. Place dots of butter or drippings on potatoes and pour over the apples and potatoes a syrup made of sugar and water boiled together. Baste with syrup from time to time until apples are done. Serve on a platter with potatoes in center. This dish is particularly good served with pork.

Summary

Potatoes furnish energy, mineral salts, and bulk. They are a good cheap food to supplement the cereals or bread and lend themselves to combinations with many other foods. Good combinations are:

Baked potatoes and beef loaf.
Pan-roasted potatoes and roast beef.
Creamed potatoes and lamb chops.
These are offered as suggestions merely, and any housewife can elaborate them to suit her own needs.

MORE POTATOES

Will Be Eaten

If Potato Growers Will Give More

Thought To The

HOUSEWIFE

Who Must Peel And Use Them

POTATO STORAGE

P. E. CLEMENT

Successful storage of potatoes depends upon the maintenance of a dry atmosphere and a low temperature in the store house. To secure the first requirement it is necessary to have a correct system of ventilation, and in our cold climate the ventilation system should also provide the low temperature needed.

Ventilation

Ventilation is secured by making use of the principle that warm air is lighter than cold air, and will be forced out at the top of a chamber if cold air is allowed to enter at the bottom. Any arrangement of shafts and ventilators that provides for cold, outdoor air entering at the sides and bottom and warm air escaping at the top, should give a building sufficient air circulation for storage purposes.

Chemical Generation of Heat

Heat is being generated constantly in a potato warehouse by the cellular or chemical activity which is going on at all times within each tuber. The more dormant the potato becomes the less heat it produces. The cellular activity is quite pronounced when the potatoes are first dug and continues until the temperature is reduced to between 32° and 40° F. This fact is evidenced by the sweating of the tubers which is noticeable for some time after they are placed in storage. The greater the chemical activity, the greater the deterioration of the potatoes, so it is desirable to lower the temperature in the warehouse as soon as possible after the potatoes are placed in storage.

Disinfection of the Warehouse

A month or so before time to use the warehouse the walls and partitions should be sprayed with a good disinfectant. For this purpose copper sulphate, in the proportion of one pound to five gallons

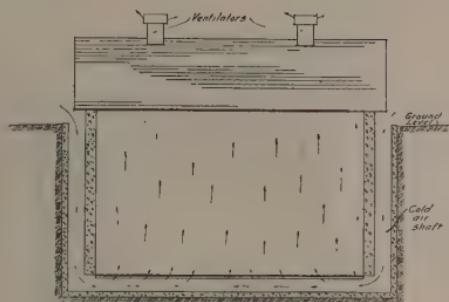


FIG. 1. SIDE SHOWING VENTILATING SYSTEM.

of water, is good. It may be applied with any kind of a pressure pump with a spray or sprinkle nozzle. The windows and doors of the building should be left open so that the whole interior may become thoroughly dry.

Cooling

It is not unusual to have some quite warm weather in the fall, after the potatoes are stored, when the warehouse becomes very warm. For this reason it is a good practice to leave doors and windows open during the nights and cool days, closing them during the warm days. This helps to dry the potatoes as well as to lower the temperature.

This practice may be continued for some time after the outside temperature has reached freezing point, because of the fact that a large amount of heat is produced by the potatoes.

A Plan For Ventilation

Since heat is being produced by the potatoes in storage, good ventilation may be secured by simply providing a means for cold air to enter under the bins. It will rise through the potatoes and force the heated air out through ventilators at the top, so maintaining a constant circulation. The cold air may be brought in by a device which is very simple if it is installed when the house is built.

A cold air shaft may be built down the

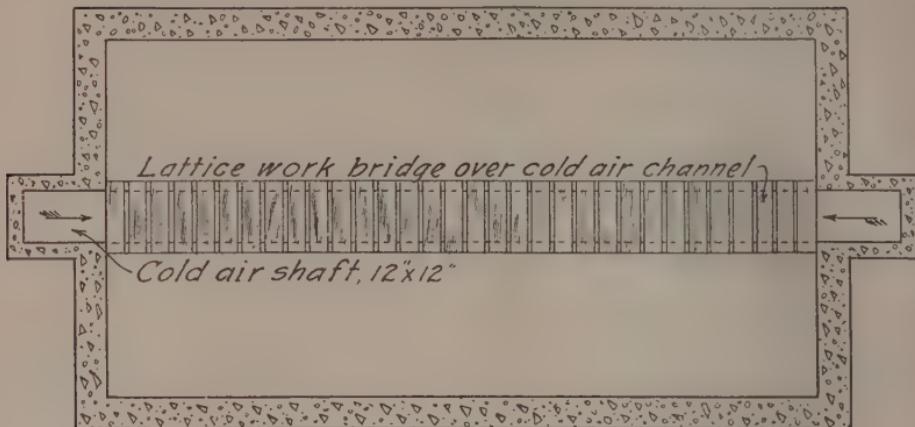


FIG. 2. PLAN OF BIN WITH COVERED AIR CHANNEL.

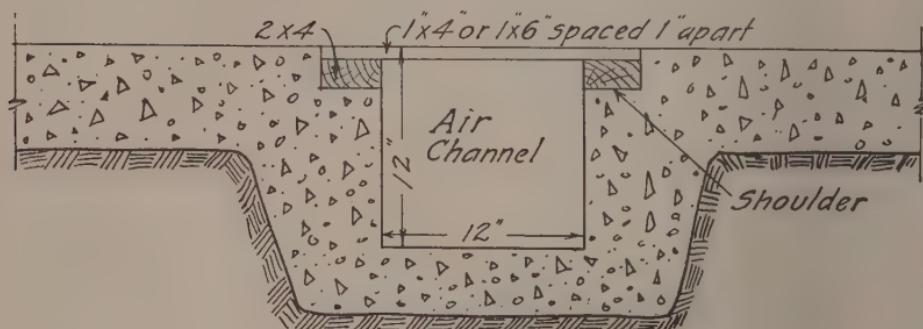
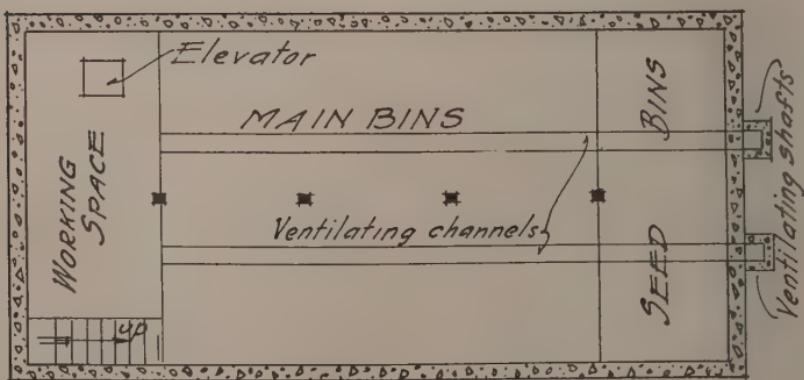


FIG. 3. END VIEW OF AIR CHANNEL.



BASEMENT FLOOR

FIG. 4. PLAN OF BASEMENT.

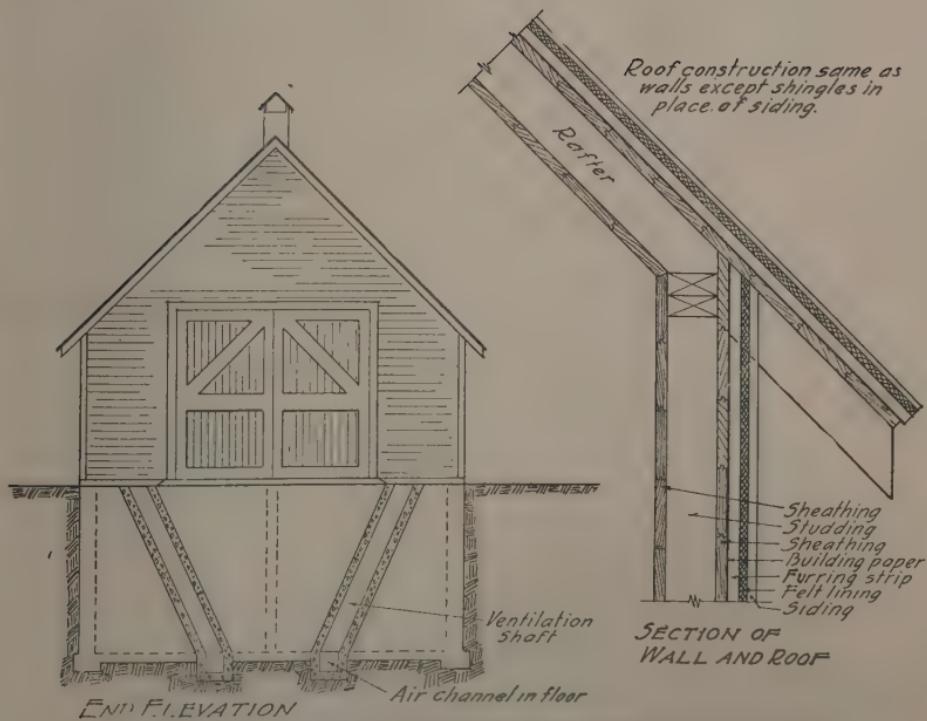
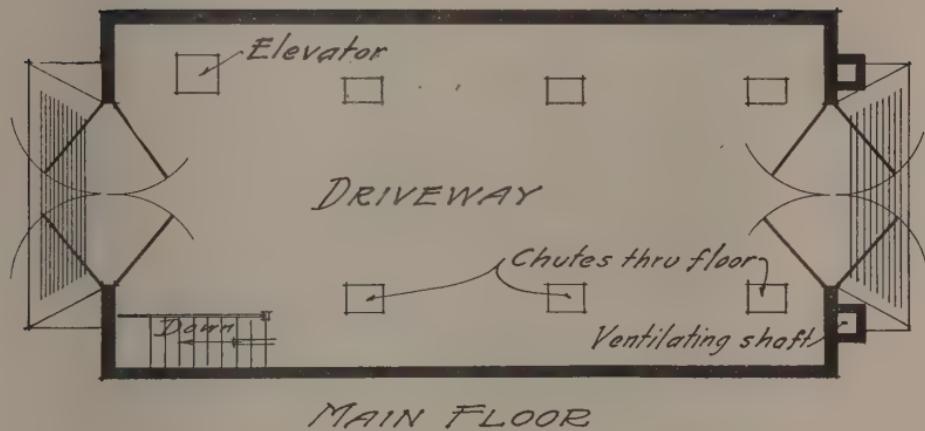


FIG. 5. PLAN OF FIRST FLOOR, END ELEVATION AND DETAILS OF WALL AND ROOF.

outside of the wall, about one foot square. This will continue through the wall and along the channel in the floor from end to end. A cross section of this channel is shown in Figure 3a. Shoulders are made along the top of the channel, Figure 3, b and c, to support the lattice work bridge, Figure 2, so the upper surface of this bridge may be level with the floor and not interfere with shoveling.

If the warehouse is already constructed with a cement floor laid, the system may still be installed, by constructing the cold air shaft, either inside or outside the wall and by building a lattice channel in sections about eight feet long, or any length convenient to handle. These may be laid in place before the warehouse is

filled, and then removed when the potatoes are taken out.

The advantage of this system over those ordinarily used in warehouses is that it allows for a circulation of cold air up **through** the potatoes. Allowing the cold air to enter through windows or through some shaft, and escape through a ventilator at the top, does not dry nor cool the potatoes lying against the floor and wall, because they are out of the air currents. It is not enough to let cold air into a store house. It should come in at the right place, and it should be in constant circulation through the potatoes. A system which provides for this will save a great deal of deterioration through the season of storage.

Potatoes Are Not Cobblestones

Don't handle them as if they
were unless you wish to lose
heavily by

*Storage
Rot*

Clean your Storage Bins before putting in a new season's crop.

Clean and Disinfect
It Pays!

STORING POTATOES IN A PIT

P. E. CLEMENT

Mr. Jacob Hurner, of Glyndon, Minnesota, has been storing potatoes in pits for many years. He has been so successful in keeping them that we will give in his own words a description of the method he employs:

"I dig a hole about six feet wide and three and one-half or four feet deep, and as long as I need, depending upon the quantity of potatoes to be stored. I fill the pit full and heap the potatoes up as steep as they will lay. Then I cover them with old, coarse hay about a foot deep after it is pressed down. I cover this with about a foot of dirt, except along the ridge where I leave a strip about a foot wide the length of the pit. This is for ventilation.

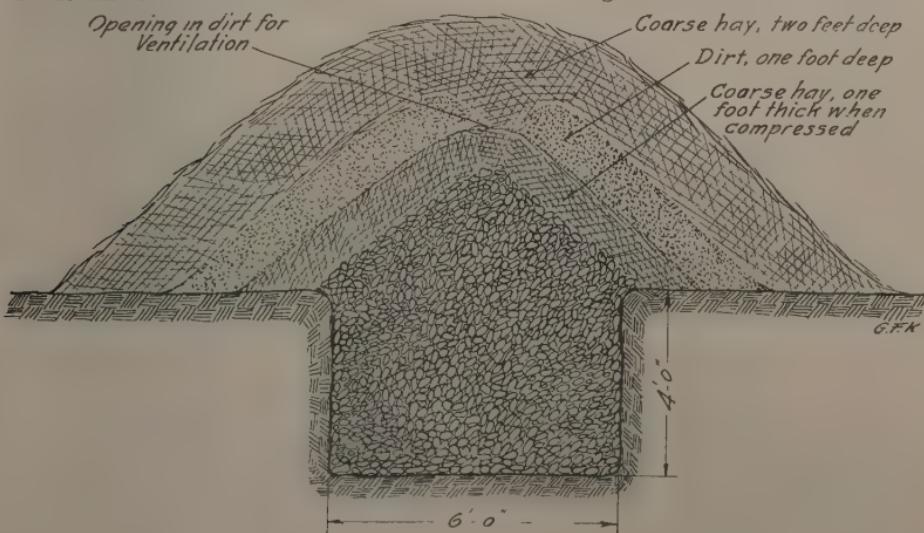
"The important point in keeping potatoes is to get them dry. The moisture from the sweating of the potatoes is allowed to escape through the hay along the ridge of the pit. I leave them this way till the ground is frozen quite hard, and then I cover the strip with dirt and throw about two feet of coarse hay or straw over the whole pit, letting it lay about six feet to each side. I consider

POTATOES
STORED
in
PITS
KEEP WELL

coarse hay better for this purpose than straw as it is less likely to blow off, and it catches the snow better.

"In order to keep water from running through the hay in case of rains, it is a good plan to make a ridge by nailing two wide boards together and laying over the opening in the banking, until the opening is closed and straw thrown over the whole pit.

"I have kept my seed potatoes this way for the past ten years and have never lost over half a bushel of potatoes, and they were frozen because of carelessness in throwing the dirt over one corner."



HOLDING POTATOES

A. D. WILSON

We are frequently asked in the fall of the year whether or not we would advise the holding of potatoes for selling later. There are so many elements involved in this matter that we do not believe any one is able to answer this question with very much assurance.

We submit below a table showing the average farm price of potatoes in Minnesota each month for ten years, 1909 to 1918, inclusive:

Potatoes: Price per Cwt. on First of Month

August.....	\$1.28
September.....	1.10
October.....	1.00
November.....	1.00
December.....	1.00
January.....	1.05
February.....	1.13
March.....	1.18
April.....	1.17
May.....	1.30
June.....	1.28
July.....	1.32

These figures indicate quite clearly that those who marketed their potatoes early in the fall or in August during those years, did better, on the average, than they would have done by holding their potatoes over. Those who held until May, June or July the following year received on the average about 30 cents per hundred more than those who sold later than August the previous fall. In storing potatoes one must consider the loss of interest on the money tied up in potatoes, the loss due to shrinkage, the risk involved from freezing, or other loss, the cost of storage, etc.

Other factors that are worthy of consideration in the matter are, first, that the averages given in the table above do not by any means indicate what may

happen in any one year. The potato crop, as is well known, is a perishable crop, and it is impossible to carry stocks of potatoes over from one year to the next. This means that the total production each year represents the total amount available for consumption.

Play Safe or Speculate?

There are several viewpoints to take. If one wishes to be conservative and play safe it will evidently not make very much difference whether one sells (1) all in the fall; (2) all in the spring; or (3) part in the fall and part in the spring. Any one of the plans will likely work out well if persisted in year after year. To "strike it right" and sell in the fall when potatoes are as high or higher than they will be the following spring and to hold over when they are to be considerably higher in the spring than in the fall is to speculate. Speculation is uncertain.

There is, of course, in some years a small importation of potatoes, but this is a factor usually of not more than one or two per cent of the total produced in the United States, so that we believe that it is a matter that may be overlooked.

Production per Capita

With a view to furnishing each individual a basis for determining for himself the advisability of holding potatoes this particular year, we submit another table showing the total production of potatoes in the United States for the last eleven years. We show also the estimated population of the United States for each year, the production of potatoes per capita, the average farm price in the United States received by the producers on December 1st of each year, and the average price received the following May:

As would be expected, these figures show that when the production is low

Total Production of Irish Potatoes in the United States Each Year for Ten Years 1909 to 1918, inclusive; also average farm price December first each year and May first the following year.

Year	Production in millions of bushels	Total population of U. S. in millions	Bushels of potatoes per capita	Price received by producer:	
				Dec. 1 (Cents per bushel)	Following May 1, (Cents per bush.)
1909	389	92	4.2	54.1	38.4
1910	349	93.5	3.7	55.7	62.5
1911	292	95	3.1	79.9	127.3
1912	420	96.5	4.3	50.5	48.2
1913	331	98	3.4	68.7	71.4
1914	409	99.5	4.1	48.7	50.5
1915	359	101	3.5	61.7	94.8
1916	286	102.5	2.8	146.1	279.6
1917	442	104	4.2	122.8	80.1
1918	400	105.5	3.8	119.5	118.9
1919	349	107	3.3		

per capita there is considerable increase in the price received by those who hold over their potatoes, while in the years when the production is rather large per capita the figures generally indicate that those who held their potatoes have lost. We do not profess to have wisdom enough to advise whether it is desirable to hold potatoes or when to sell. Some people are clever enough to speculate on the market and win out; others lose by speculation. The tables given represent facts that we hope may be of help to our readers in deciding for themselves whether to hold over their potatoes or not.

Get Crop Reporter

It is worth while for every farmer to retain the above table or a copy of it. Also write to the United States Department of Agriculture, Washington, and ask

for "The Monthly Crop Reporter" as published; it is free. These reports will keep you somewhat posted as to crop conditions throughout the United States. As soon as the yield can be determined, or about September 1st, you will get a crop report showing the estimated yields for the year. Find out as in the table the total production for the United States, estimate the total population and find the production per capita. This information may be helpful to you in determining what to do with your potato crop.

Another source of valuable information available to farmers without charge is the daily market report gotten out by the Bureau of Markets, Minneapolis. A card addressed to Bureau of Markets, U. S. D. A., Minneapolis, will bring this to you without cost. It is published during the heavy crop moving season.

P. E. Clement Says it Just right

Read what he says about marketing potatoes. It contains a lot of the

Juice of Knowledge

and "knowledge is power" in marketing potatoes as in other things.

MARKETING POTATOES

P. E. CLEMENT

Since all agitation for market system reform comes from a desire to influence the market price of goods, it is appropriate that we begin a discussion of marketing by calling attention to certain factors which always affect the price of farm produce. These factors are independent of the market system and will not be eliminated, though they may be modified, by radical changes in the methods and routes of distribution. Because of the existence of these fundamental facts, it is not safe nor wise to claim for any market system that it will always operate equitably and profitably for all concerned; nor is it justifiable to condemn as a failure a new marketing venture when it fails to arrest or change the influence of these factors.

Factors Which Affect the Price of Farm Produce

The visible supply of the product and the demand for the same are always important factor. We pay a relatively high price for what is rare and scarce, and a relatively low price for what is produced abundantly. This law of supply and demand affects the price of all farm produce from year to year, and we all, whether buying or selling, base our terms upon the estimated production for that year. The price of potatoes is very noticeably influenced by this law because of the perishability of the product and the fact that the American crop is almost entirely consumed in this country. An over production of potatoes depresses the price very much during the marketing season because the surplus cannot be stored and carried over to another year as grain may be. A considerable shortage raises the price because consumers increase their bids in order to obtain a scarce article.

The production of potatoes is likely to vary greatly from year to year. This is largely due to weather conditions but

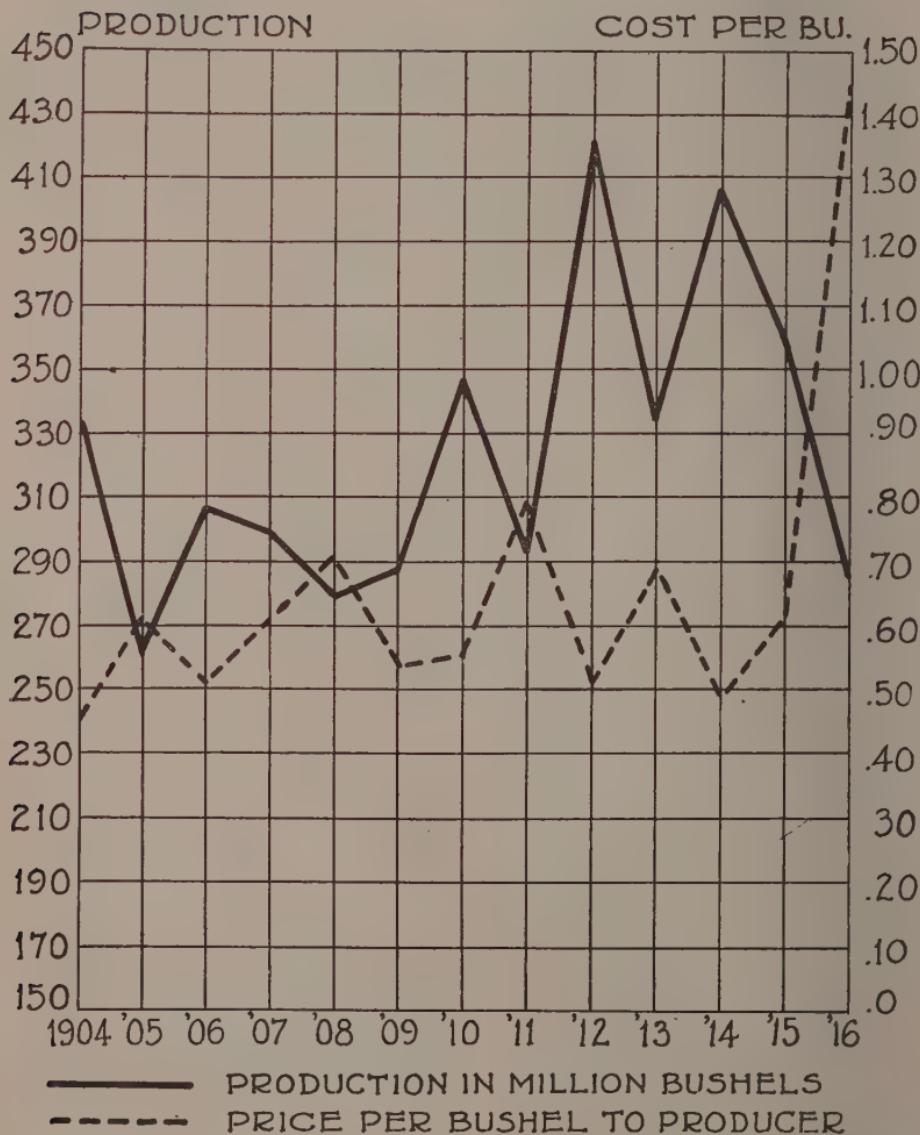
to some extent is due to fluctuations in acreage planted. After a year of over-production and low prices, growers are likely to reduce their acreage somewhat and unless the yield per acre is greater than normal we have a year of low production and high prices. This see-saw of potato production and prices is illustrated by the graph on the following page.

A Variety of Uses

Many uses and various markets for a commodity tend to stabilize its market price, which is another reason for the pronounced fluctuations of the price of potatoes. In America this product is used in its natural state for human food and for seed, almost exclusively, and as these demands are fairly constant from year to year, over or under production is quickly felt. If there were a greater demand for potatoes for starch, for flour, for wood alcohol and for stock food the market would be more elastic and the price more steady.

Distribution of Shipments

The distribution of shipments during the marketing season has a strong influence on price. The demands for any crop, and the facilities for transporting and storing it are fairly fixed. If the entire production for a season be thrown upon the market at harvest time, a glutted market results, and the price is depressed. This influence not infrequently proves more powerful than the law of supply and demand and in a year of sub-normal production we may see growers receiving a price which is lower than the supply warrants, because the crop has been crowded upon the market. A few months later, the price is again regulated by supply and demand, and those who bought and stored the crop realize large profits. This seemingly unfair division of profits, which causes discontent among



growers, might be eliminated by a closer study of the markets, and better distribution of shipments.

One of the most important elements in the success of the California Citrus Fruit Growers Exchange is the care with which they distribute their shipments, both as to time and as to destination. Their product rarely enters a glutted market. This price-affecting factor is one which may be largely controlled by the proper marketing machinery, and should be one of the first reforms to be undertaken by organized potato growers.

Quality of Product

The quality of the product will always affect its price. There is always a spread between a No. 1 grade, and inferior stock, and no effort to increase the price received for a product can be long successful if it does not include a plan for improvement, or at least maintenance of the quality.

These recognized factors and their influence upon the price of produce must be taken into consideration when we plan to reduce costs and increase profits by a reform of our marketing system.

Our Market Machinery

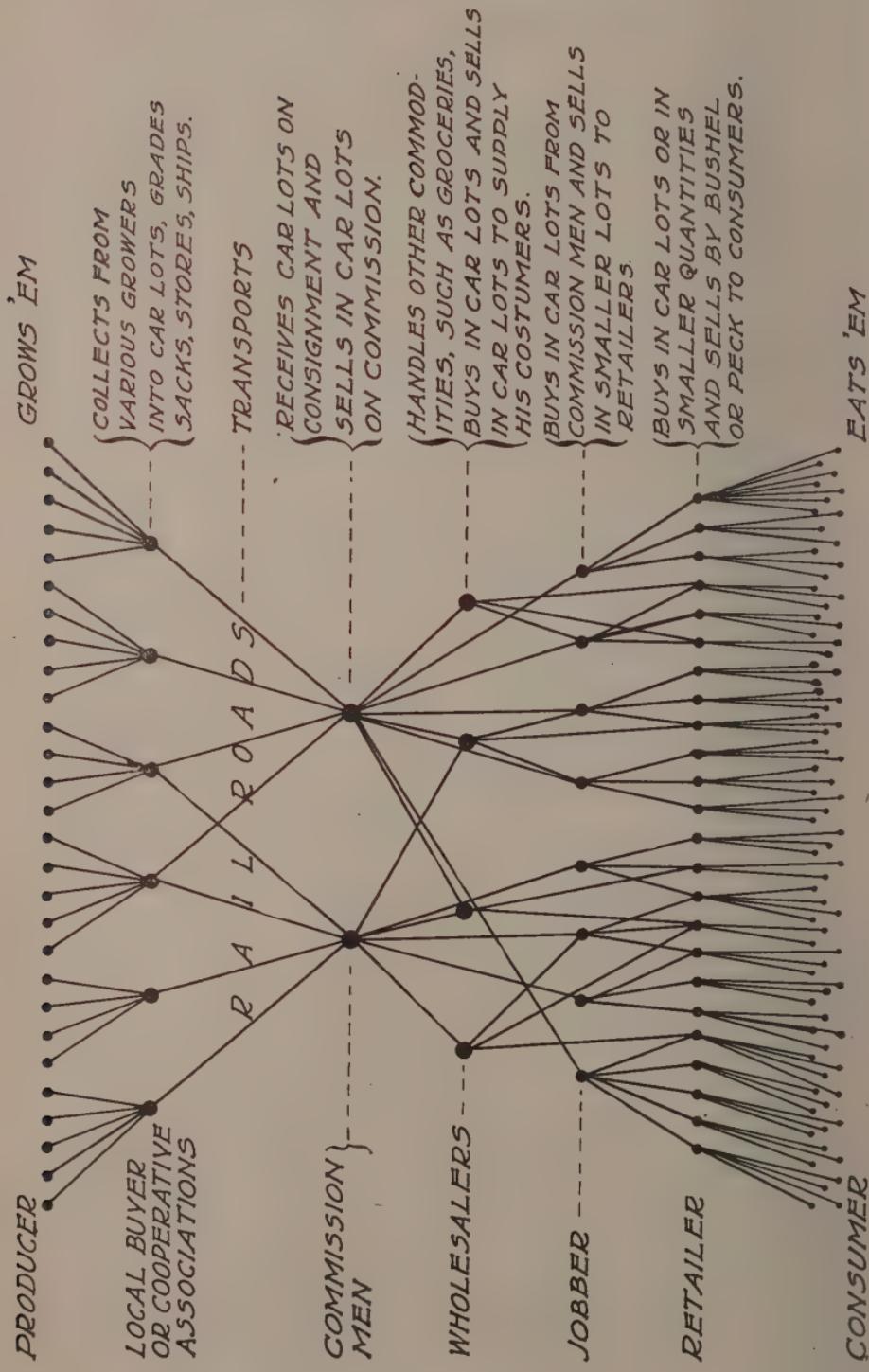
The old-time exchange of the farm surplus for the simple necessities handled by the village store has developed into an elaborate market system with so many phases that it seems cumbersome and topheavy until we consider the magnitude of the service and the breadth of the country over which the system is spread.

Just because it is so complex that it is not readily understood the market system is made the butt of all economic agitation, and he is a poorly equipped reformer, indeed, who has no beautifully thought-out plan for remodeling it. Probably one reason why the abuses which exist are not more quickly corrected is that this very multiplicity of would-be reformers befogs the issues.

The Market Route

A criticism most often heard is that the route between the producer and consumer is too long and devious. The less one understands this route, the more willing he is to decry the system and propose to reform it by the sweeping proposition to "Cut out the middlemen." In the case of potatoes it is not at all difficult to trace the route between the grower and the consumer, and this seems a proper beginning for a study of the potato marketing system. Below is a graphic illustration:

As seen in the graph, potatoes pass through a number of agencies and receive a definite service from each, on their way from the field to the table. First they are planted and harvested by the **grower**, who may produce several varieties and grades, and who does not make a study of the market. The grower sells to a **buyer**, who collects carlots of the same grade and variety and sells or consigns the carlots to dealers in some large central market. If he consign them to someone who will act as his agent in selling them, taking a commission for the service, the potatoes pass through the hands of a **commission man**. If they are sold outright, they become the property of a wholesaler. Sometimes one firm performs both these services, and sometimes the commission man sells to the wholesaler. The terms are used rather loosely, but we may speak of two steps here, because two services are performed. These big companies, whether selling on commission or buying outright, are known to the trade as **first-hand receivers**. They receive large shipments from local buyers from a large territory, store them and distribute them during the winter months, when it is most expensive to care for perishables, they invest large amounts, and assume great risks, and they have an expert knowledge of the market. From the first-hand receivers the potatoes are bought by **jobbers**, who buy carlots and sell to retailers or large consumers like restaurants, in less than carlots. From



the **retailer**, who buys in small quantities, and sells in very small amounts, giving an elaborate and expensive service, the potatoes pass to the **consumer**, who is particular about what he buys and wants it delivered and charged. The price paid by the consumer in the spring will be more than double that received by the grower in the fall.

To those who feel that the producer should receive the major portion of the price the consumer pays, we commend the thought that the time from harvest till spring is equal to the time from planting till harvest, when they are under the growers care. And that the risks and expenses and labor of sorting, grading, shipping, storing, and finding markets is at least comparable with that involved in planting, cultivating, and digging them.

The route as described is sometimes shortened. In a few cases the producer sells directly to the consumer, thereby eliminating all the steps between. This can happen only when the two live in close proximity, and very few potatoes can be marketed this way. Large consumers or consumers' associations may buy from the local buyer. Retailers and jobbers may buy in carlots from the local buyer, eliminating the service of the wholesaler. But these cases are isolated and exceptional. The great bulk of the potato crop passes through the course described. The reason for this is that it has thus far proved to be the most efficient and economical system. Small buyers, such as jobbers, retailers and consumers find it too expensive and uncertain to seek out the growers who have just the grade and quality they desire. Growers cannot spend time or money needed to seek out markets for their produce. The wholesalers and other large dealers assemble all sorts and grades, store them, and sell to others who break up carlots, and distribute to smaller customers.

It is obvious that all the services named must be rendered by someone. To eliminate one step means simply to re-

Travels of a
Potato
Grower
to
Buyer
to
Commission
Man
to
Jobber
to
Retailer
to
Consumer

*And it costs
Money to
Travel*

Successful Co-operative Potato Marketing

DEPENDS ON

*The Efficiency
And Economy
Of the Association's*

MANAGEMENT

quire another to perform two services—which cannot be depended upon to reduce costs, for service must be paid for.

Suggested Reforms

The remedies most often recommended for too expensive market machinery are direct marketing and co-operative marketing.

Direct marketing of potatoes means a direct sale by the grower to the consumer, and is practicable only when they live within wagon haul of one another, or when, living far apart, they both handle carlots. These conditions preclude the possibility of a very general adoption of direct marketing of potatoes. The bulk of the United States potato crop is produced in seven states, and is marketed all over the forty-eight, so direct transactions between grower and consumer are quite out of the question. Individual growers often work up a nice trade

for their product by finding a special market but as a matter of market reform the direct sale must be discounted.

The efficiency of co-operative marketing depends upon many conditions.

What May We Expect From Co-operation?

Co-operation in marketing is frequently recommended as a means of "eliminating the middleman" with the argument inferred, if it is not stated, that this means a saving to the grower of one or more dealers' fees. This argument is misleading. The co-operative association of growers may take the place of a middleman—their local buyer—which is not eliminating, but replacing, and the service he performed is done by the association. The saving effected depends upon the efficiency and economy of the association's management. It cannot be the entire amount of the dealer's fee, for

Co-operation Means

A limited amount of stock to each man.

A single vote for each member, regardless of holdings.

Division of profits according to patronage.

These are the essentials of Co-operation

Get them fixed in your mind.

the expense of operation, of time, of labor and of investment must be deducted in one case as in the other.

Another cause of disappointment in co-operative marketing is caused by a misunderstanding of the term "co-operation." There are many concerns operating under the name "co-operative" which are in fact only farmers' stock companies. Their capital is secured through the sale of stock, and their business is conducted like that of any other stock company. They market their own product, but they also buy, at market prices, the product of other growers and sell it at their own risk and profit. Dividends are divided according to stock, among share holders. There is no objection whatever to farmers so engaging in any business they choose, but the use of the term "co-operative" is unfortunate since it is misapplied and discredits real co-operation. A farmers' stock company can offer a better market to the outside producer only when the management is more efficient and more honest than its competitor. This condition may be probable but it cannot be assumed. Non-stock-holding patrons of such companies are not usually enthusiastic over that form of co-operation, for they find very little difference between them and the ordinary company doing the same business.

Essential Features of Co-operation

There are three essential features found in a truly co-operative business enterprise. These are: a limited amount of stock allowed each man, a single vote for each member, regardless of holdings, and a division of profits according to **patronage**. It is plain that an organization embodying these features is conducted for the benefit and profit of all concerned and its business policy is formed by all its members. Many of the most successful co-operative associations do not own stock at all.

Difficulties and Dangers to Avoid

Although our economic landscape is

strewn thickly with the bleaching remains of perished co-operative enterprises, there are many operating successfully, and a system of co-operation seems to be the logical highway to the market reform everywhere demanded. There are, however, rocks and pitfalls to be charted, that they may be avoided.

The simplicity of co-operative organization has been exaggerated by enthusiasts. It looks too easy, and is too lightly undertaken. This form of doing business is not easy—it is difficult, and its demands are such as fall rather heavily upon the farmer accustomed to live much to himself, giving his whole attention to the sowing and reaping of his crops. As a member of a co-operative marketing association this farmer must take on some additional duties and responsibilities. Meetings must be attended, markets must be studied, the product must be graded and packed according to regulations approved by the organization. The individual grower cannot always determine just when and how his crop shall be marketed. He cannot receive the pay for it when he unloads it at the local station or warehouse. If his organization is highly co-operative his product loses its identity when it leaves his farm and he is simply credited with the amount he contributes to the pool, and he receives his compensation **pro rata** from the returns. He can no longer cling to his pet notions and prejudices regarding the matters which concern the organization as a whole, for first of all, a co-operative association must have unity and agreement among its members. This is the deadhead that has wrecked many promising enterprises. Co-operators must be willing to bend to the will of the majority and continue loyal to their organization.

Management

An organization formed under the most favorable auspices must still be ineffective without an efficient business manager. Such a manager must possess some qualities which are unusual and hard to find

It is not enough that he be a good accountant, or that he be honest and fair. He must know the product handled, know men, and how to meet them, and know the market.

Since a co-operative marketing association nearly always enters into competition with existing agencies from the time of its organization, it seems that its logical course is to employ as its manager a man who knows the market game better, and is in every way better equipped for the work than his competitor. It is also logical to assume that a man so equipped must receive a remuneration at least commensurate with what he would realize if he were in business for himself. It is a penny-wise-and-pound-foolish policy to employ a cheap manager, and a good one cannot be gotten for an insignificant salary.

Members are not always willing to delegate to their manager a sufficient amount of independent action. It is necessary to trust a great deal to the manager's judgment and integrity; for although he is in fact the paid agent of fifty or more farmers, the business must be conducted as though it belonged to one man. There must be quick decisions, prompt attention to orders, and an alertness to seize advantages which cannot be gotten if the manager must consult members before each important move. An association outlines its general policy in its articles of incorporation and by-laws, and checks up its business in annual and other meetings, but its manager must be trusted to carry out its purposes, without too much carping over details.

Business Policy

The selection of a business policy is one of the important decisions to be made by a new organization. Members frequently reason that since their organization has the machinery for buying and shipping, it is quite in order for them to buy from non-members and speculate upon the purchase. Considering that every co-operative association believes,

at the outset, that it can conduct its business more economically than any existing agency doing a similar business, the members are not unreasonable in their argument that to buy from non-members is a charitable act, mutually beneficial. "We are going to cut out all needless expense, so we can afford to pay a better price than the buyers, and can still make a good thing for the association," they say.

Such a course pursued means almost certain failure for the association unless it has the advantage of unusually strong financial backing, and a remarkably skillful manager. The ordinary organization does not have sufficient capital to sustain the losses incident to a speculative business. Nor do members have patience with such losses. If this policy is adopted, the co-operative features are more than likely to be lost sight of and the association will fail entirely or become the tool of a few men for their own benefit.

If the association wishes to give non-members the advantages of their market service, the best way of doing so is to allow them the privileges of members, handling their produce the same as that of members, but charging a higher rate for service. A very satisfactory plan is to withhold a certain per cent of the returns from non-members and apply it upon payment for stock, so that after a certain amount of patronage, the non-member automatically becomes a member and share-holder. Whatever the policy of handling the produce of outsiders, it should be in keeping with the co-operative idea, and not be speculative.

It is also important that the right method of handling the produce of members be adopted. If members feel that they must be paid for their crop when it is delivered at their local station, or warehouse, they had much better not attempt co-operative marketing.

There are several reasons why it is impracticable for the co-operative association to buy the produce of its members. One is that the amount of capital required

is more than the organization can safely furnish.

Such a policy is unfair to some of the members and gives others an undeserved advantage. This is best explained by an illustration of the working out of such a plan. If the manager buys for one week on a falling market, paying each day for the produce delivered that day, and sells at the end of the week for a price below that of a few days previous, it is plain that the men who sold early received a better price than those who sold late, but their stock brought the same returns into the association. If the transaction results in a loss, it is not shared equally.

In the case of a steadily declining market the association must continually lose. Individual buyers, who trust to make up their losses in a better year, and who have capital or credit to carry them through, may survive a season of losses, but very few co-operative associations can. The members become discouraged and withdraw their support, and the venture fails.

Pooling

The best way to avoid any appearance of unfairness in marketing is to pool the product of the association, making up shipments from a number of farms, crediting each grower with the amount he contributes, and making the returns *pro rata*. This gives all members an equal chance to share in advantageous markets. Expenses and losses are also shared equally. This plan is the acme of co-operation, and is being used with signal success by the California Citrus Fruit Growers. Men who are inexperienced in co-operation are scarcely ready to undertake such a highly developed form of collective marketing. The new organization can more safely employ the simple plan of making up shipments from the produce of those who are ready to market at that particular time, as is done by livestock shipping associations. As the members become accustomed to working together, the practice of pooling will be more favorably received.

Financing the Organization

The ability of the proposed association to finance its operations must be considered before organization is effected. Even if it is not to buy or advance money on sales, the funds needed for advertising, organization expenses and managerial salaries are not small. Common methods of meeting this requirement are to sell stock, to secure loans from local banks, to take loans from commission firms as has been common with grain elevators, and to have the funds advanced as loans by members of the association. These methods are not unusual and need no elaboration.

The Spirit of Co-operation

If other conditions are favorable, capital is easily secured. The element that is most frequently lacking is the true spirit of co-operation, which will prompt members to cast aside prejudice and suspicion, to overlook mistakes, to accept unavoidable losses, and to stick to their organization through everything, for the common good.

In the past it has been an axiom that farmers will not co-operate until unendurable conditions force them to it, but it is likely that the success of those organizations which have weathered the storms of their first undertaking is becoming an incentive to other farmers to launch co-operative enterprises as a matter of business rather than as a retaliatory measure.

Possibilities of Co-operation

The difficulties to be met by co-operative marketing organizations are not listed here for the purpose of discouraging such projects, but rather with the hope that by pointing out the especial danger to be encountered, new organizations might be prepared to meet and survive them. We need more co-operative marketing associations, and with the right spirit and a sound business policy back of it such an organization should be successful. However, there is nothing

The acme of co-operation
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POOLING

Pooling means the making up of shipments from several farms, crediting each grower with the amount he contributes, and making the returns pro rata.

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automatic about co-operation, nor is it a guarantee of profits. Like any other venture, its success depends upon its ability to do its work better and more efficiently than existing agencies. Its proper object is the elimination of needless waste—of time, of materials, of labor, and of expense.

Local Associations

In attaining this object a number of advantages are gained by the small local association, made up of a small group of growers and working independently. Probably the most important gain is the experience of working together, which opens the way for larger undertakings. Their product is standardized, and self-imposed rules for grading and packing raise the standard of quality for all. Advertising campaigns can be carried out which would be out of the question for individual growers. New markets can be sought and developed. The fact that the pooled product can be marketed in carlots is a decided advantage, especially to small growers. Through the manager a very efficient news service can be established, which will keep all members in touch with the conditions of the market. If the association is competently managed there may be at the end of the year, a very respectable amount of savings to be divided among members and patrons. If the association has been formed for the sake of dividends it is more than likely to be disappointed, however. During the first years large returns cannot be expected. The real profits and benefits are realized only after the business is well established.

Limits of Local Associations

It is evident that the scope of the local association is limited. All the possible advantages may be realized; the local market may be quite appreciably influenced by the organization, and it may pay satisfactory dividends to the members, and yet the association's influence upon the general market is negligible. Sup-

posing it replaces the local buyer entirely, it still must make use of the usual first-hand receivers in the large central market. From there on their product is passed along the customary route. No one but the members, and possibly patrons, receive any benefit from the co-operation.

If co-operative effort is to be made a remedy for market evils it must be developed beyond the local association. Instead of many independent organizations working alone and for themselves, we must have a system of co-operation which will carry our product far along the market route, and exercise a powerful influence upon market conditions. Some of the groups of producers who have organized for extensive marketing are the California orange growers, the apple growers of the Northwest, raisin producers, and Virginia gruit growers. These, and other groups, are getting such satisfactory service from their associations that it is quite likely that other producers will rapidly follow suit.

A Minnesota Potato Growers' Co-operative Association

Everything indicates that Minnesota potato growers have reached the stage in their industry where a large co-operative marketing system may be put into operation. Such a system to be successful should grow and develop instead of being adopted at once, and as a whole. It is not safe for us to observe the work of some other group and decide that we will form an organization exactly like theirs. Each organization must be adjusted to the conditions under which it shall operate, and it is much better to begin simply and to progress wisely, even though it be slowly, than to be moved by a great enthusiasm to subscribe to an ambitious program of co-operation before any of its features have been tried out. For this reason we give only a brief suggested outline for a Minnesota Potato Growers' Co-operative Marketing Association.

We have the proper beginning for such an organization in the many local associations which have been organized in every potato-producing section of the state. These organizations are not all alike and it is not necessary that they should be. It is assumed that each one is serving its territory in the way most acceptable to it. If any are not they can easily be changed so that they are workable, provided there is a **will to co-operate** back of them. They all manage their affairs as they elect, raise their capital in their own way, make requirements for membership, and in every way work independently of each other.

Many of these local associations are trying to serve too large a territory, and have members living too far apart, growing and marketing their produce under slightly different conditions. It would probably be better if they were broken up into smaller groups. A small organization made up of the growers around one shipping point would be more desirable as there would be an opportunity for closer co-operation and better understanding.

If all these small organizations, and the many others that should be, and will be, formed in the near future are carrying out a full program of co-operation, which includes improvement of product, advertising, marketing, possibly buying supplies, and an efficient news service, it is evident that there is a great duplication of service. If they are not working correlatively at all, their influence outside of their own small community is restricted and negligible. It is even possible that without meaning to compete they may defeat one another's purpose.

District Association

To accomplish the best results the small organizations should be federated together in a larger organization which we may call a district association. Since there are many important matters which affect all the potato growers of one section alike, these matters of mutual in-

terest may properly be made the business of the district association. This is not only economical, but gives the local associations, as members of the larger body, a much greater influence than they can have working alone and independently of one another.

One of the functions of the district association may be to manage all shipments from the district. The local organizations may still sell locally to cash track buyers if they desire, but the district manager will bill out all shipments, and make collections for the same. The advantages of this arrangement are that the district manager, and through him, all the locals, will know where the stock is going, which will aid in distributing shipments; and the central organization will have better facilities for looking up the standing of customers, and can make collections easier than the small association manager.

In one section or district the product is similar, and its market is to be sought among buyers of a certain class—as the seed stock of Early Ohios grown in the Red River Valley, which is marketed among growers of the Southern states, who favor this northern-grown stock. This fact makes it economical for the local associations to co-operate in their advertising, and leave that part of their business to be managed by the district. The same amount of money spent in a systematic advertising campaign which would benefit every grower in the district, will accomplish much better results than when spent for local advertising by the many local managers.

We have stated before in this paper that no co-operative enterprise should neglect a program of improvement of its product. This is another project which should be made a matter of district control. Standardization, grading, inspecting, packing, disease control, seed plots, all the details of improvement of the growing and packing of the product may properly be under the jurisdiction of the district management. This will mean a standardized output from the whole district, and the

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—*P. E. Clement*

larger the amount of a certain standard product, the greater will be its influence upon the market.

Another very important function of the district association is the maintenance of a specialized market news service. One of the real disadvantages a grower encounters in selling his own product, is the fact that he does not know the market. If growers, or local co-operative associations, know the conditions of the various central markets, the current price, the conditions under which digging is being done in various producing sections, whether or not any of these sections are experiencing a car shortage, and other items of market news they can sell as advantageously as anyone else. But the individual grower is not in a position to get the late market news, and the local association does not feel justified in spending a sufficient amount to keep as well informed as the ordinary buyer is. But through their district manager the growers should be able to have the latest and most accurate news obtainable. To the news of the outside market the manager may add the amount of shipment from their own district up-to-date and all other items interesting to the locals, and issue this bulletin daily to all local managers. The value of such a news service cannot be over-emphasized. One association which has given special attention to this side of its business estimates that its distribution of market news kept the price at their shipping station from 15 cents to 20 cents per cwt. above the price paid at stations around them.

If co-operators wish to use their organizations for the purpose of buying supplies needed in their business, they can buy in larger quantities and to a better advantage if it is done through the district manager. Some of the fruit growers have gone further and own and operate plants for manufacturing such supplies as boxes and carriers. In the matter of securing labor through the busy season the district office may also be made use of.

We have spoken previously of the importance of securing competent managers for the associations. When the associations unite in employing a district manager, they are able to get a more competent man than most of the locals can secure. With a district manager who is thoroughly acquainted with all the phases of the business, and knows potatoes in the field as well as on the market, the locals may employ as their managers, less experienced men, perhaps some of their own members, who can attend to the affairs of the local organization, and heartily co-operate with the district manager.

It would devolve upon the local managers to look after the grading, packing and loading of the product shipped from their associations; to enforce the rules of the district relative to these matters; to co-operate with the district manager in the work of improvement outlined; to receive and transmit market news; and to hold his own organization together.

The management of the district affairs should be vested in a board made up of representatives from the local organizations. The board should meet regularly to attend to the business of the district. It should hire the district manager, make rules and regulations for grading, packing, and labeling the product, and outline the general policy of the association. The best way for financing the district association is probably by a levy upon each hundred pounds marketed through the association.

State Organization

After the work of the districts is well established it may be found advisable and desirable to federate the districts in a state organization. In this organization the districts would unite in maintaining such departments as affect all the growers of the state. Some of the affairs to be left to the state administration would be the matter of transportation facilities, such as arise in case of car shortage; claims, in which all claims

against transportation companies, warehouse companies, commission firms, and similar companies, would be presented for members of the association; collections; and a legal department retained for the use of member associations in case of litigation. Advertising of a certain class could also be carried on by the state association.

Such a system as here outlined, if it is consistently developed, with a membership of perhaps 60% of the state's potato growers, can reasonably be expected to practically cover all of the market machinery up to the jobber, who breaks car-lots. In many instances it would go

further and reach the retailer and even the consumer, in the case of seed potatoes.

The outline given here is not intended as a working model, but is only suggestive. Although the plan sounds Utopian, it is in reality practicable and can be put into effect as soon as growers are ready to co-operate to that extent. Many groups of growers are now co-operating under a similar plan, and are getting very satisfactory results from their co-operation. Michigan potato growers have already formed a state-wide organization and are urging Minnesota and Wisconsin to join them in the forward step.

A State Potato Exchange Pays

Michigan's state exchange handled and sold potatoes for its patrons at 20 cents per hundred pounds for the grower.

No private buyer can operate on that margin.

Minnesota is a Greater Potato State than Michigan and ought to have a Potato Exchange too.

THE MARKETING PROBLEM

LUDVIG MOSBAEK, ASKOV, MINN.

If we seriously consider taking steps to reduce the cost of living, one of the first things to be done is to shorten the gap which exists between producer and consumer. The question is: How can this be done? Some say by government ownership or control of production and distribution. I am convinced, however, that this will not solve the problem to the satisfaction of either party.

It is a recognized fact that there is in very many instances a seemingly unreasonable margin between the price the producer receives for his product and the price which the consumer pays for the same. I have before me a statement from a gentleman in Illinois. A friend of his in Alabama had raised 20 acres of sweet potatoes, and had written about how well satisfied he was with the result. He said he had harvested from 150 to 200 bushels to the acre and had sold at the rate of 75 cents per bushel of 56 pounds; thus receiving from \$112 to \$150 per acre. The Illinois man found that the local grocer in his town was selling sweet potatoes at 10 cents per pound, or at the rate of \$5.60 per bushel; a difference of \$4.85. I have had similar statements from consumers of potatoes and rutabagas in Minnesota. In some instances the consumer paid from 200 to 500 per cent more than the producer received. It is no wonder that the wage earners demand higher wages.

I know from experience here and in Denmark that this margin can be cut to a just minimum if we will only organize and co-operate in building a bridge over the gap from both sides; that is, eliminate all unproductive middlemen and speculators and gamblers. Whenever a person buys something which he does not need he is either a speculator or a fool; and whoever sells something which he does not possess is either a speculator or a fool. We do not need to consider the fool in

this case, but the speculator in nine cases out of ten will succeed in making a margin of profit that justly belongs to the producer and consumer and which should be divided in proportion to our willingness to co-operate on the one side in marketing and on the other side in buying.

Successful co-operation may be likened to a tripod, the three legs of which are, one, raw material; two, management; three, loyalty. So long as we want the dealer (speculator) to assume the risk he is entitled to his expenses, a fair profit and as much more as he can get. I look upon his business as legitimate, and we should not call him names. If we can do his work cheaper or better we have a perfect right to do so; and we can do it *if we will co-operate*.

Co-operation in Askov

In the spring of 1906 the so-called Danish colony settled around Askov on cut-over timberland which was covered with a heavy, twelve-year-old growth of brush. Conditions were such that we found no ready cash sale for our products. We were able to trade a few dozen eggs and a few pounds of butter for groceries, but there was no cash market. We organized an egg marketing association, put up eggs in cartons with a special mark or number for each individual producer, and the association made an agreement with retail merchants in Duluth who took our product at 5 cents a dozen above market quotations.

Another co-operative movement was the founding of the Pine County Farmers' Mutual Fire Insurance Company which now carries risks amounting to two million dollars.

In 1907 we organized our farmers' club which soon developed into a co-operative feed-buying association with a turnover for 1918 of \$45,953.15 and net earnings of \$2,647.45. This buying association,

Shorten the Gap

between
PRODUCER
and
CONSUMER

*This can be done by
Co-operation*

Read what has been done at
ASKOV, MINN.

which adopted the name of Askov Co-operative Association, is at present building a new feed store and elevator to cost about \$8,000.

Our Creamery

In 1911 we organized a co-operative creamery with 200 cows to furnish the raw material. We bound ourselves to deliver our cream to the creamery for a term of years, or till we had paid for the plant. We had borrowed \$2,600 with which to build and equip the creamery. The annual report for 1918 showed a production of 138,876 pounds of butter which was sold for \$66,222.37. We furnish the raw material, cream, and get all there is in it less the cost of manufacture and transportation. A part of our butter is sold to retailers in Duluth. This means only one middleman has a chance at it. If we could sell it to a co-operative consumers' store there need be no middleman.

Marketing of Vegetables

Our first united effort to market perishable farm produce was launched when our farmers' club, in 1910, in co-operation with other clubs, organized a Producers' Co-operative Market Association with headquarters in Duluth, in conjunction with the Commercial Club which furnished considerable financial backing. A manager was employed and a store rented, and business went along very satisfactorily, increasing from month to month for about two years, when, without warning or notice of any kind to the board of directors, the Commercial Club declared all ties between them and the association at an end. That is what we got for not standing on our own legs. I suppose the commission men who were also members of the Commercial Club did not find the competition from the real producers desirable.

My Marketing Experience at Askov

After the abrupt closing of the marketing association in Duluth in 1911, I

marketed my produce directly to commission houses in Duluth and Minneapolis, but found the service very disappointing, and came to the conclusion that vegetables must be produced and marketed in carload lots.

In the year 1913 a Minneapolis firm erected a potato warehouse in Askov. Their manager offered me \$5 a ton for rutabagas. I did not accept the offer, and succeeded in selling my crop (2 cars), and some for the neighbors at \$8 a ton f. o. b. Askov.

When I loaded the second car, about November 1, we had a light frost and the last two wagon loads were slightly frozen on top of the loads. The agent, a young man, happened to see these two last loads when they were put into the car and wrote on the bill of lading: "Frozen on loading." I did not know that frost could hurt the quality of rutabagas, and made no objection to the loading of these two loads nor to the notice on the bill of lading. I know positively that the frost did not harm the rutabagas, but the commission firm to which they had been sold rejected the shipment, stating that the contents were badly frozen and damaged. They, however, offered to take the shipment at a reduction of \$100 or half the original price. I wired a friend to take charge of the car, and he took another commission man to the car and showed him the contents all through and sold it to him at the same figure as I had previously sold it to the first firm. The car was then switched to the warehouse of the second party which happened to be next door to that of the first firm.

Just what passed between the two firms I, of course, do not know; but I had a telegram from the second party to the effect that the rutabagas had been frozen, but that they did not think the injury was serious, and they promised to do the best they possibly could with the consignment. My friend let them have the car, and the result was that my final returns amounted to exactly what the first



MR. MOSBAEK AMONG HIS BEES

firm had offered me, that is, \$100. I have found time after time that if there is the least opportunity to claim a reduction in price many commission merchants are inclined to take undue advantage and graft a fat slice of a shipment. Hence, it must be the policy of every shipper to grade sharply and load only first-class produce. This is the only way to gain a reputation and avoid great losses and trouble in adjusting and reselling the produce. That was my first year in the business, and I paid \$100 for that one lesson. I think today it was well worth the price, but it seemed pretty hard at the time for dollars were pretty scarce and a lot of them were needed to clear land and pay for the necessities of life.

The next year the farmers wanted me to buy their produce. This I refused to do, but I offered to ship for them for a consideration of 50 cents a ton to pay for loading and other expenses, and agreed to pay for the produce when I got the returns. I shipped that season, 1914, five cars which I managed without loss and got a good price; in fact, so good that the farmers increased their acreage considerably. The following year, 1915, I called a farmers' meeting and told something about my experience in growing and handling rutabagas and cabbage, and proposed the organizing of a shipping association or some arrangement for shipping through the farmers' club. My propositions were not adopted, and when fall came I offered to ship on the same conditions as before, and did ship all the

surplus rutabagas that were raised in the neighborhood that year—a total of 14 cars—and received better prices than before.

In 1916 our farmers' club offered to hire me as manager for shipping their produce. They offered to pay me not only 50 cents per ton as before, but all the expenses connected with telegraph and telephone service, printing and mailing circulars, etc. But I was convinced that if they would not organize and promise to dispose of all their produce through the club or shipping association, I might be handicapped in disposing of the produce to best advantage. And so it happened to turn out before the season was over.

As nobody was prepared to ship when the rutabagas were ready for market, I offered to ship on the same conditions as before, and shipped out about ten cars. Then a Minneapolis firm offered to buy rutabagas and pay cash on delivery. At the same time the farmers' club began to load a car. Being urgently requested by several farmers to buy for cash, I finally consented to do so. I bought the two cars that had been loaded by the parties mentioned above, and also several cars which they loaded later. I made a standing offer to pay 50 cents a ton more than the other parties would offer. I could do this because I had prepared for the campaign. I had made out a list of selected commission houses and brokerage houses, and had circulars printed and mailed to them. By proper management of the shipping I could avoid glutting any market, and so keep the price going up. I bought several carloads in Sandstone, Friesland, Hinckley and Brook Park. Finally the local club of the Society of Equity entered the game and loaded a car. They refused to sell me this car, as they preferred to ship it and take what the market would bring. I got permission to put a wagon load of rutabagas in their car; and the same day I put three loads in the car which the farmers' club was loading. I paid the farmers \$20 a ton that day for a carload which I loaded and shipped on my own.



MR. MOSBAEK'S BARNs. THE ONE AT THE LEFT WAS BUILT IN 1906; THE OTHER IN 1916.

account. I sold my own car for \$22 a ton. When I got returns from the farmers' club car I received \$18.90 per ton, and from the Equity car, \$15.50 per ton.

All through that season while I was buying produce I felt out of place and although I made money I decided to quit gambling in the hope that our community would sooner or later be ready for co-operation in marketing. At the annual meeting of our co-operative association in 1918 I once more suggested the organization of a shipping association, but the majority were not ready for it and no action was taken. Finally in the middle of the summer in 1918 a good many of our farmers became nervous about the situation and a meeting was called and the produce association was organized on a basis of \$25 shares and compulsory sale of all our produce through the association. A potato warehouse about 42x60 in size was built and equipped with modern machinery for grading and handling the potatoes. We agreed to a deduction of 5 cents for each one hundred pounds of produce sold, to be added as new shares and in that way raised over \$1,000 the first season. The house and equipment cost us about \$6,000 and at the end of the season in the spring of 1919 we owed about \$3,000. The house will hold about 10,000 bushels and is too small. We should have built at least twice as large and shall probably do this before the end of another

season. I told the members at the organization meeting that they must not count on me as a manager, that younger and stronger men than I could be found. However, when the house was nearly finished and the shipping season began and they had not found anyone to tackle the job, I consented to take hold and do my best, well knowing it would not be smooth sailing. We handled the produce on the basis of paying for it after we had the net returns, less the expenses and freight. We deducted, as I mentioned before, 5 cents for each one hundred pounds to be applied on additional shares to pay for the house, and we also deducted 10 cents per hundred pounds for operating expenses. When I commenced shipping for our produce association we were unknown in the trade and I decided to consign to reliable commission houses and have our potatoes sell on their merits on arrival, and we generally got the top prices on the days our carloads sold. In the latter part of the season when we were well known I had no difficulty in selling f. o. b. Askov and could draw sight draft with bill of lading.

We are very fortunate in Askov in regard to the commercial quality of our potatoes. We grow practically only one variety—the Green Mountain. This is due to the fact that about 12 years ago Mr. A. J. McGuire, then superintendent of the Grand Rapids Experiment Sta-

tion, recommended that potato to us at a meeting of our Farmers' Club.

We decided to grade our potatoes to comply with United States grades and during the shipping season I compared prices paid to farmers reported in the daily government reports and found that we generally netted 10 cents and sometimes up to 25 cents a hundredweight more than the average price, but still we did not do as well as the Michigan Potato Growers' Exchange, and I could clearly see that to make marketing a success we eventually would come to the same point as the Danish co-operative associations came in 1884 when the local associations organized a central wholesale organization that had in 1914 a turnover of more than \$20,000,000.

Successful co-operation always begins

at home, whether it be a buying or marketing or any other economical or social affair. It must originate and develop from the local communities to form a sound foundation, and the local units will naturally unite their efforts to overcome obstacles which are too large for them to combat single-handed.

True co-operators do not gamble but buy what they need when they need it and sell their own products when ready to market, in such amounts daily as the market will readily absorb. A co-operative organization should not buy in the open market the products of its members or those of other farmers for manufacture or sale. An individual can gamble and take an occasional loss and recover but a producers' or consumers' co-operative association very seldom recovers from a heavy speculative loss.



POTATO STORAGE HOUSE OF THE FARMERS' CO-OPERATIVE PRODUCE ASSOCIATION OF ASKOV.

POTATO WAREHOUSE ACCOUNTING

By FRANK ROBOTKA, UNIVERSITY FARM

The bookkeeping in potato warehouse associations is in a much less satisfactory condition than that found in most of the other types of marketing associations. Frequently no financial records at all are kept and rarely is a complete double entry system used. Still more rarely is a paid bookkeeper employed. Under such conditions it cannot be expected that reliable figures will be readily available to serve as a basis for determining sound business policies, costs of operation, the relative profitableness of specialized, non-related departments, or even the actual financial condition of the business or the relative progress which is being made from year to year.

Reasons for this state of affairs are not difficult to find. Much less progress has thus far been made in the development of this than in other types of marketing associations. The volume of business, except in certain highly specialized producing areas, is relatively small, frequently so small that were it not for other activities undertaken, dissolution would of necessity follow. Greater risk is involved because of the perishable character of the commodities handled. The business is seasonal, a crop may fail occasionally, and the potato market is very apt to be unstable. These difficulties result in frequent changes of managers and a considerable diversity in methods of business operation, which in a final analysis are the main reasons for the weaknesses which exist in connection with their accounting.

The diversity of the business methods employed and the frequent changes from one method to another constitute one of the most important problems confronting potato warehouse associations. And here again it is the frequent changes rather than the method employed which is the source of the greatest evil. If the association decides to pool its products, it

should pool consistently from year to year; and if it decides to sell on commission or buy for cash, consistency is likewise a virtue. It is a gamble to attempt to anticipate the market situation each year with a view to pooling in a season of rising prices and to paying cash during a season of falling prices. Even though this were feasible, and the grower were satisfied, the risk involved in the latter situation would speedily bankrupt the association, unless a large margin were taken.

It cannot be expected that an efficient system of accounting will have been developed where the business practices themselves are in a constant state of flux. Where the produce is pooled a different and much more complicated system of accounting is required than where produce is bought for cash. The cash system will not meet the requirements where the produce is bought or sold on commission. Unfortunately the business methods which are regarded as being most truly co-operative and involving the least risk, i. e., pooling and selling on commission, are the methods which require the most complicated bookkeeping, and undoubtedly this fact has tended to discourage their more general use.

Before the bookkeeping problem can be solved some sort of solution will have to be found for the business practices problem. This involves a study of the practices which are actually being used, the conditions under which they are used, and their weak and strong points. In this connection we will do well to profit by the experiences, in so far as they apply to our conditions, of the other states which have made an especially conspicuous success of this type of marketing.

Standardization, which has meant so much in marketing as well as in other fields, will, it is believed, do much toward

improving the situation with respect to the business practices and accounts in potato warehouses. That due allowance will have to be made for differences in local conditions goes without saying, but this does not mean that there cannot be standardization with respect to the fundamentals involved in good bookkeeping even under dissimilar conditions. Sound accounting principles must be applied regardless of the business methods employed, but their application is rendered much less difficult when the business methods themselves are sound and more or less standardized. A uniform system of bookkeeping will tend not only to standardize the business methods but to raise the standard of bookkeeping as well. Aside from the usual marketing advantages which may be expected to result from such a step, federation of the local associations into a central association would, it is believed, be a long step forward in the direction of more efficient business management in all its phases. In Michigan, and some of the other states where federation has been the means of solving some difficult problems, the federations have not overlooked the bookkeeping problem, which too frequently

is regarded as a mere detail, but have taken a definite stand and in some cases exercise a considerable degree of control or supervision in the matter of the system used, audits, etc.

Instruction in Warehouse Accounting

The University Department of Agriculture through the Division of Agricultural Economics has under way a study of the problems involved in the organization, operation and management of potato and produce warehouse associations. Information is being gathered regarding the experiences of existing associations operating under various conditions and under different plans of organization, the difficulties they have encountered, methods of financing, bookkeeping requirements and other related questions. On the basis of this information it will be possible to outline a sound plan of organization, to suggest methods of conducting the business which have proved most successful and to devise a uniform bookkeeping system or systems suitable for general adoption. Warehouse accounting may then be included in local short courses such as are being planned in country elevator and creamery accounting.

**Good Book-keeping is a Great Help in
Operating a Potato Warehouse.**

**It makes Available Figures On Which To
Base Business in the Future.**

***KEEP BOOKS
AND KEEP THEM RIGHT!***

POTATO MACHINERY

L. B. BASSETT, UNIVERSITY FARM

Twenty years ago practically all the potatoes produced in this country were grown without the use of potato machinery. This method of production required many hours of man labor to produce an acre. Seed potatoes were cut by hand, planted by hand on land plowed with hand plows, hand-digging was the custom, and sorting if resorted to at all was done by hand. Most of the cultivating was done with the one-horse cultivator and many potato growers thought they must hand hoe their crop.

Contrast this with the modern method of production where the cutting, planting, spraying, cultivating, digging and sorting was all done by special potato machinery, and we can readily see why the hours of man labor per acre had been reduced.

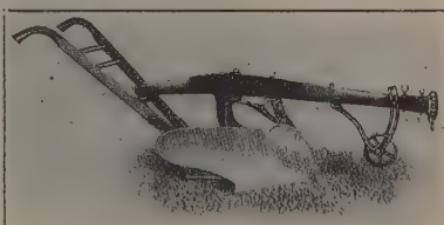
Minnesota Bulletin 179, "Cost of Producing Farm Crops," gives the hours required to produce one acre of potatoes as 54 man hours and 78 horse hours. This is the average covering a 5-year period, 1913-1917. Most of the farms on which these data were secured used modern potato machinery.

While there are no records available showing the hours required to produce an acre of potatoes under the hand method, I believe the horse hours would be cut down at least one-fourth and the hours of man labor doubled. If this be true the cost per acre under the all-hand method applying the present price of labor would be about \$7.17 more than the cost where modern potato machinery is used.

This extra cost is made up as follows:

54 hours of man labor	
at 25c per hour . . .	\$13.50
Less machinery cost per	
acre	\$2.43
Less 19½ hours horse	
labor at 20c	3.90
	— — —
	\$7.17

This represents a cost of .0717 cents per bushel on the basis of 100-bushel yield, or .047 cents per bushel on a 150-bushel yield. The machinery cost is made up of the interest on investment, depreciation and upkeep of machinery used to produce an acre of potatoes.



CHILLED PLOW WITH JOINTER

The Plow

Potatoes require a deep, mellow seedbed and for this reason special attention should be given to the plowing of the field. Deep plowing and thorough pulverizing of the seedbed is essential to the highest degree of success. In the lighter soils the chilled plows give the best results. These should be used with a jointer. The jointer helps to cover the trash and weeds. If potatoes are grown on clover sod, which is perhaps the best practice, the chilled plow has just the right shape of mouldboard to completely invert the furrow slice and leave the field in fine shape for the disk harrow.

There are, however, many soils in Minnesota where the chilled plow does not scour. In these localities the steel plow must be used. If the practice is to follow clover with potatoes, the turf and stubble or general purpose bottom will do a better job of plowing than the stubble bottom. If the practice is to follow grain crops with potatoes, plowing under the manure, then the stubble bottom equipped with combination jointer and rolling coulter will give the best results.



ONCE OVER WITH THE DISK HARROW ON FALL-PLOWED CLAY LAND. NOTE LUMPY CONDITION OF SOIL.



SAME FIELD AS SHOWN ABOVE DISKED TWICE BY LAPPIN GONE HALF. THE SOIL IS WELL WORKED UP BUT THE SEED BED IS NOT FINISHED. IT NEEDS CROSS-HARROWING WITH A SMOOTHING HARROW.

The Disc Harrow

If potatoes are to be planted on clover sod and the manure has been spread on top of field after the land was plowed, the disc harrow is the best tool to work up the seedbed. It cuts up and thoroughly mixes the manure and first two or three inches of soil. It is equally good in heavy clay soil where the land has been packed down by rain or snow. If the single disc is used it should be lapped one-half to prevent ridging. If a large acreage is grown the tandem disc will give best results as it leaves the field level and covers more land with much less man labor. It is very important to use tools that keep the ground level. If this is not done it is impossible to plant at a uniform depth and the potatoes will not come up evenly. Fields full of ridges are very hard to cultivate.

The Spike Tooth Harrow

Some form of spike tooth harrow is necessary to finish the seedbed. The object of the spike tooth harrow is to level the high places and fill the low places;

it also helps pulverize the lumps. If field has been disced or cultivated with a spring tooth harrow the spike tooth should be driven crosswise to fill tooth marks and level uneven places. For sandy soil where penetration is not essential, the flexible harrow will be found to give excellent results. Especially is this harrow good where manure has been applied on top of the field as it clears the trash better than many other harrows. It is especially good for harrowing potatoes after they are up as it does not injure the plants as much as other harrows. Most flexible harrows are made reversible; hitched from one side the teeth slant; if hitched from the other side the teeth are straight.

The ordinary lever harrow, either wood or steel bar, is also a good machine. It is considered better in the heavier soils as it has greater weight and more penetration. If land is not disced or spring toothed, it should be harrowed several times to make a seedbed. Going over it twice with teeth set straight, and twice over with slanting teeth should put it in good shape.



PORTION OF FIELD ON LEFT HAS BEEN HARROWED ONCE, AND THAT ON RIGHT TWICE, BY SPIKE-TOOTH HARROW.

The Tower Pulverizer and Acme Harrow

If the ground is not hard and is free from trash, the Acme Harrow will give excellent results. This often is better

than a disc, especially on lighter soils as it does not ridge the land and for the same horse and man power has nearly twice the capacity. However, it is not so good on trashy land or on land that is soddy or



ONCE AND TWICE OVER WITH ACME HARROW



ONCE AND TWICE WITH TOWER PULVERIZER

stony. It, however, must be followed by a smoothing harrow to finish the seedbed.

Tower Clod Crusher

The Tower clod crusher is a good machine with which to prepare a seedbed when land is not soddy or covered with

trash. This machine not only cuts up the surface but levels and pulverizes the field as well. It is a sort of combination knife harrow, spike tooth harrow and planker. It leaves the seedbed in ideal condition where it can be used. If land is very hard it should be gone over twice crossing the marks the second time.



THE MEEKER HARROW CROSSING A FIELD THAT HAS BEEN DOUBLE DISKED. THIS LEAVES THE LAND IN IDEAL CONDITION FOR PLANTING

The Packer

In the lighter soils one of the nicest machines to finish the seedbed with, or better yet to run over the field after planting, is the culti-packer or sometimes called pulverizer. If used after seed is planted this machine firms the soil down around the seed which aids in movement of soil water. It also leaves surface of soil corrugated, which helps to prevent blowing. On heavy clay soils, however, this machine is little used and of doubtful value except where soil has been allowed to bake and become lumpy, then it helps to pulverize the lumps.

The Weeder

The weeder is a special purpose tool good for cultivating potatoes after they are up, especially on the lighter soils. This implement does not injure the young potato plants and helps to preserve the surface mulch and kill small weeds that may be started in the hills. On heavy clay soil it is of doubtful value.

Potato Cutters

There are three ways of preparing seed for planting. First use small tubers and plant without cutting. Second, cut the seed by hand, and third, cut the seed with a cutter. The first method is impractical and not conducive to good yield. The second is perhaps the best from the standpoint of accuracy of work and judgment of selection, and as a general rule should give better results. However, it is expensive and slow and where a large acreage is to be planted and labor hard to secure and costly to keep, the machine method is perhaps the most economical. One objection to machine cutters is that they cut uneven sized pieces. This can be remedied to some extent by using care in selecting seed, selecting tubers of uniform size and shape and setting cutter for the seed. In selecting a cutter look for one in which the knives can be easily removed for sharpening and adjustments made to take care of different sizes and shapes of potatoes. Some cutters can also be used for cutting beets, carrots,



SEED POTATO CUTTER

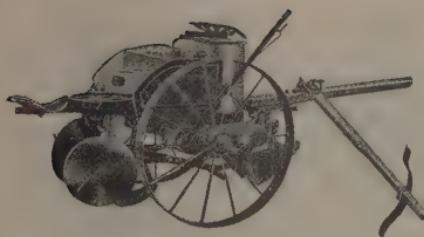
etc., for stock feeding. The knives on a cutter should be rigid and the socket for holding potatoes in place when being cut should be snug fitting so that a clean cut is made. A cutter that cuts pieces in short blocky shapes is to be preferred to one that cuts long, slender pieces.

Planting Potatoes

There are two methods of planting potatoes, the hill and the drill method. In the commercial potato-growing districts the drill method is very generally followed. Where weeds are very troublesome or on light land that is poorly supplied with moisture and fertility the hill method is perhaps best.

Where only a small patch of potatoes is to be grown the plan of plowing them in is not bad. In this way the seed is dropped by hand in every third furrow. The depth planted is regulated by the depth of plowing. In using this method the person dropping carries the seed in a pail and drops seed against left hand wall of furrow, spacing seed by short steps and dropping seed between side of foot and wall of furrow.

Another method of planting is to use the wing shovel cultivator. This tool is sometimes used for hilling. If used for planting it should have a gauge wheel and the wings laid back so as not to leave a very wide furrow. The covering can be



THE BELL DROP TYPE OF PLANTER.

done with a lever harrow by crossing the furrows and setting the teeth at a sharp angle.

Planter

In selecting a planter two things must be kept in mind; (1) accuracy of drop. It makes no difference how perfect a planter may be in other respects if it does not drop accurately it reduces the yield. (2) The deposit of seed in the ground and the covering. It makes little difference how accurate the drop if the planter fails to place all the seed all the time in the bottom of the furrow and cover at a uniform depth, it is not doing the best work. On the other hand, if a planter fulfills these two requirements the other features, as draft, ease of adjustment, etc., are of minor importance.

Potato planters may be classified in several ways, as to number of rows planted and as to style of drop. The two-row machine is heavier and of course requires more power than the single-row. It must be less flexible as to uniformity of depth and covering than the one-row machine; however, if ground is properly prepared it does excellent work with less labor cost.

One-row planters are made for both one or two horses. The one-horse machine is identical with the two-horse planter except the operator walks behind the planter. For the man who wants a planter and has only a few acres to plant this machine should give satisfaction. In the potato-growing sections of Minnesota, however, the one-row two-horse planter is the favorite.

Potato planters have two distinctive styles of drop, the cell drop and the picker drop. The cell drop, see Fig. 00, is oper-

ated by two men or one man and a boy. The feed wheel revolves automatically, the cells are loaded under the hopper and seed dropped through the boot into the bottom of furrow as the seed wheel passes over the opening at top of boot. The boy riding on the back seat simply corrects any errors that the machine may make. With this drop it is possible to get 100% perfect plants. This disadvantage is the extra man labor involved, though this work is often done by a boy or cheap labor.

The picker style of planter is the most common type in Minnesota. This machine is entirely automatic and is operated by one man. In this type of drop the seed potatoes are speared on the end of a sharp prong and carried to the top of boot opening and there discharged into the boot and deposited into the furrow.

Like the cell drop the thickness of planting is regulated by the speed of drop arm. This type of drop is more likely to injure the seed. It occasionally drops two pieces in a hill and sometimes misses a hill. However, when machine is in good condition and seed properly cut it plants between 90 and 100% perfect. In operating this planter care should be taken that the picker and discharge are properly adjusted.

Furrow Opening Devices

There are several forms of furrow opening devices, as the single disc, double disc, shoe and shovel or combination disc and shoe. The important points to consider in studying the furrow openers are evenness of depth, penetration, proper covering and a furrow opener that will work under all conditions without bother. So far as penetration is concerned the single disc is best; however, on lighter land the single disc is more likely to plant deep. With the single disc furrow opener it is also harder to get all seed covered so evenly. For trashy land the disc furrow opener gives best results. For uniformity of depth on a well prepared seedbed and for neatness of deposit, it is hard to beat the shoe though it bothers in trashy land and does

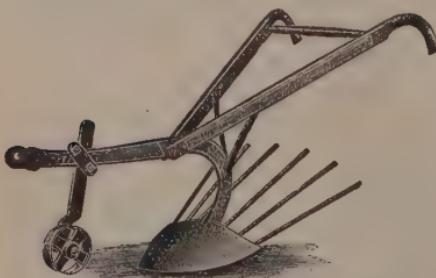


SHOVEL OR PLOW DIGGER WITH AGITATING FINGER RODS.

not have enough penetration for soddy or hard soil. The double disc opens a slightly wider furrow and comes more nearly getting the seed in the bottom of furrow than the single disc. In some shoe furrow opening planters a guard is run ahead of shoe to protect it from stones and also to brush aside trash that might interfere with the shovel.

Digger

There are two different forms of diggers. The shovel or plow digger and the elevator digger. For the man who is growing only a small amount of potatoes the shovel digger will give good results, especially if the potatoes are planted on



SHOVEL TYPE OF DIGGER WITH STATIONERY FINGER ROD. GOOD ON CLEAN FIELD

sandy soil and the field is kept free from weeds. Some of the shovel diggers are equipped with vine turners that help move the vines to one side. A gauge wheel or double gauge wheel should be used as this enables the operator to keep his digger at a uniform depth. Some of the shovel diggers are equipped with agitating rods that shake the dirt from the potatoes, the intention being to leave the

potatoes in a clear row on top of the land behind the digger. If potatoes are grown in clay soil or if the soil is wet during digging, this type of digger is better. Still another type of shovel digger is sold with stationary extension rods behind the point. This type of machine does excellent work on light sandy soil that is free from weeds but does not work so well on heavy clay soil.

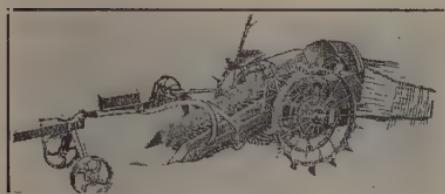
The Elevator Digger

The important considerations in buying an elevator digger are; first, a machine that does a clean job of digging; second, a machine that will separate the potatoes from soil, weeds and vines; third, a machine that will work satisfactorily under any and all conditions.

The digging part of a machine consists of the shovel or blade. This should be wide and pointed enough to give penetration. A slightly concave blade seems to hold the hill together until it is delivered to the separator.

If the blade is too broad and flat at point it may gather trash and will have greater draft. The blade should carry a high polish to insure scouring under all conditions. The relative position of the blade and trucks should be such that on uneven ground it conforms very closely to the movement of trucks. With the truck movement some machines provide a lever for angling the truck on side hills, thus holding the digger over the row. For hilly ground this insures clean digging. The depth lever should be within easy reach of the operator so the depth can be carefully watched. The sides of machine should be high enough to hold all soil and the elevator should have plenty of capacity. Especially is this important on clay soil or weedy fields.

The separating part of the digger consists of the elevator and rear finger bar rack, or in some machines the rear separator consists of a second series of bar chains very similar to the elevator chains. On light soil free from weeds this rear separator is not essential and can be dis-



REVOLVING DRUM TYPE OF POTATO DIGGER

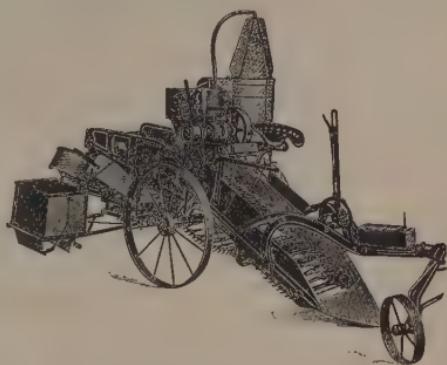
pensed with, but on heavy soil with trash or if the soil is wet, this additional separator will be found a great convenience. Where the finger bar rack is used for rear separation it generally has some kind of agitation. One make digger uses a patent shaker arm to give movement to the bars. If digging in heavy soil, especially if field is wet and weedy, the separation is very difficult. Under this condition the elevator chain needs as much vibration as is possible. In some machines it is possible to increase or diminish the vibration to suit the conditions.

In addition to the elevator and rear chain or finger bar separator, some machines provide a vine kicker placed over

these conditions it is well to choose a machine with big separating capacity, long elevator chains, a very gradual slope, plenty of shake in elevator chains; and additional rear separator with vibration or shake; a vine picker that helps to throw the vines and weeds to one side; a wide machine which gives additional separating space and large drive wheels, well lugged, to insure plenty of power.

If much side hill work is likely, a machine that allows control of direction is an advantage.

In lighter soils where weeds and mud do not occur, the short elevator without



DIGGER WITH BUNCHING ATTACHMENT

the extra rear separator or vine kicker will give satisfaction.

If only a few potatoes are to be grown on light soil, the shovel digger with stationary finger bars will give good results. If the soil is heavy use the shovel vibrating finger bar digger. For these last two machines the gauge wheel should be added.



DIGGER WITH WEED SEPARATOR

the rear separator. This kicker generally works on a crank shaft and kicks the vines and weeds to one side, otherwise they would fall on top of the potatoes. One make of machine uses an open finger bar revolving drum for a rear separator.

In buying a digger it is well to consider the following points:

For heavy clay soil sometimes it may be necessary to dig when field is wet and some seasons fields may be weedy. For



DIGGER WITH ELEVATOR

For the large digger on heavy soil where much digging is being done, it may be found advantageous to equip machine with gas engine to drive working parts and have the horses simply move the machine. A four to six horse-power gas engine of the Cushman type will give excellent results. The gas per acre to operate the digger will be between one to one and one-half gallons. One of the advantages of a gas engine on a digger is that the speed of digger can be increased at times without increasing speed of team.

Another attachment that can be had for the digger is the buncher. This carries the potatoes until a given amount

is collected, usually one bushel, then dumps them in a pile. A basket attachment may also be used and the potatoes delivered into baskets and set off as baskets are filled. It is also possible to secure a wagon box elevator. For a machine with this attachment potatoes are elevated directly into a wagon box as dug.

The objection to all of the attachments is that the machinery cannot tell the difference between potatoes, stones or clods of dirt, and if these occur they are delivered with the potatoes. In wet weather it is better to let potatoes dry before picking them up. With any of the bunching or elevating attachments this is impossible.

Machines Know No Difference Between

Potatoes Stones OR Clods of Earth

*In Picking up Potatoes the Human
Hand Can Beat any Machine*

CO-OPERATIVE POTATO MARKETING IN MICHIGAN

From *The Farmer* of June 21, 1919.

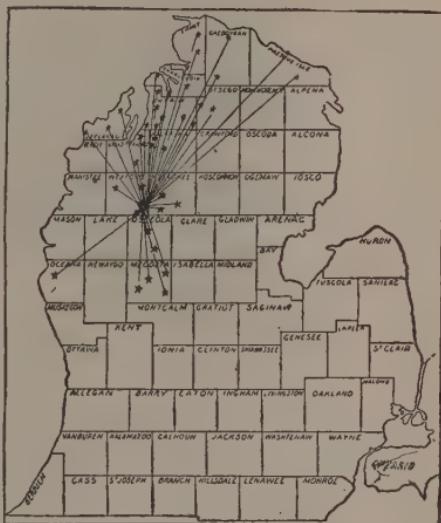
Seventy Local Associations with Eight Thousand Members Affiliating in One Central Marketing Exchange; Minnesota and Wisconsin Urged to Organize

Marketing rather than production is the problem most freely discussed by potato growers. Under existing methods by which potatoes reach the consumers, producers often fail to secure their fair share of the consumer's dollar; yet little has been done in an organized way by growers to improve their marketing facilities. Michigan is the lone state where growers have organized on a state-wide basis to solve their marketing problems.

Prior to last fall the Michigan growers were at the mercy of the potato buyers; their backs were against the wall. The buyers appeared about harvest time and contracted for the crop in the field, or, appearing later, bought it from the bins. The grower was seldom aware of the total production of potatoes or of the probable future demand. Neither was he aware of future market conditions nor familiar with the speculative elements of the potato market. He took the buyer's judgment and accepted the buyer's price.

Here and there were groups of growers who co-operated and shipped in carlots to the principal markets. Even this method had its drawbacks. The day these cars arrived on the market might be the day when side tracks were loaded with cars of potatoes, when potatoes were a drug on the market. Consequently, prices would be low. Lacking accurate knowledge of market and production conditions, these growers speculated every time they consigned a car of potatoes. They gambled on the market.

Those days of uncertainty, though, are passing for the members of the Michigan Potato Growers' Exchange. The members of this Exchange are no longer at the mercy of the traveling buyers;



Location of the 48 Local Associations First Affiliated in the Michigan Potato Growers' Exchange. There are now 55 Locals, and 15 more in process of Organization.

they do not sell to the buyers now. Neither do groups of individual growers, if members of the Exchange, consign cars direct to market, thus gambling on the price they will receive. The Exchange does all the marketing now for its members.

The organization of this Exchange assures the growers who are members that their interests will be protected. Before a car is shipped, the Exchange knows exactly what the price will be, as all its potatoes are shipped f. o. b. cars, which eliminates speculation as to price. The Exchange also has accurate information on market conditions, since it keeps in telegraphic touch with all the markets. When advisable to withhold shipments, the Exchange can hold them in the warehouses under its control, or it can re-route and divert shipments to take advantage of the best markets. Under the present hit-and-miss method of shipping

See What Michigan Did!

IT ORGANIZED a potato growers' exchange which put \$1,850,714 into the pockets of Michigan's potato farmers.

IT HAD 55 local co-operative associations at the beginning. Is it any wonder that more locals are being organized right along?

The Idea is a good one and Minnesota is Thinking of Adopting it. Why not?

potatoes, it frequently happens that one market will be greatly oversupplied, another under-supplied.

The Michigan Potato Growers' Exchange is the central marketing organization of 55 local co-operative associations. The average membership of each local is about 125 growers, giving the Exchange a membership now of about 6,500 growers. These 55 locals are located in the 14 principal potato-growing counties in the northern half of what is known as Lower Michigan.

Organization work is now proceeding in the eastern half of the Peninsula of Upper Michigan, where 15 locals are in process of organization. This will give the Exchange 70 locals and a total membership of about 8,000 growers. Eighty per cent of Michigan's potatoes are grown in the district in which these locals and proposed locals are situated. Cadillac is the home of the Exchange, and the general offices are located there.

Each local agrees to consign all of its potatoes to the Exchange for sale. Each member of each local agrees to consign his entire crop to his local. The Exchange then sells the potatoes, deducts eight cents per 100 pounds to cover the cost of handling and selling, and returns the balance to the locals to be distributed pro rata among the individual shippers after local expenses are deducted. The Exchange is to these potato growers what the milk producers' associations are to the milk producers adjacent to the large cities. The organization is very similar to the Twin Cities Milk Producers' Association.

Michigan ranks next to Minnesota and Wisconsin in potato production. Each of the three states produces around 30,000,000 bushels, more or less, each year. But Michigan, with more industrial centers and large cities, consumes more of its crop locally than does either Minnesota or Wisconsin, and Wisconsin consumes more of its crop locally than Minnesota.

Shipments from Minnesota the past winter have been estimated at 12,000

cars, from Wisconsin 10,000 cars, and from Michigan 8,000 cars. Of the 8,000 cars shipped from Michigan, 25 per cent or 2,000 cars had been handled by the Exchange prior to April 15, 1919. This will be increased to about 2,500 cars before the fiscal year ends July 1. Thus, Minnesota and Wisconsin have a more complicated marketing problem than Michigan.

The Michigan growers affiliated with the Exchange are not allowing themselves to be led by sentimental opinions. They are following sound business principles. When the Exchange was organized last summer they selected high-class business farmers as officers; they accepted the very helpful assistance of Hale S. Tennant, representing the United States Bureau of Markets, because of his experience in building marketing organizations; they put the responsibility of marketing for all the local associations into the hands of the central Exchange; and then voted to employ a sales manager, a competent man who knew the potato marketing game, regardless of what such a man would demand in the way of salary. These decisions to centralize power and choose competent men to direct the Exchange indicated that the growers meant to succeed.

Prior to the organization of the Exchange there existed in Michigan several local co-operative potato associations, similar to such associations to be found, scattered here and there, in Minnesota and Wisconsin. These associations were doing good work in standardization and improving quality; but because they were not federated, they could do little in improving their marketing facilities. Mr. Tennant then appeared in Michigan, working in co-operation with the Extension Division of the Michigan Agricultural College and the county agents of the potato counties. He found sentiment ripe for a federation of local associations, and those that then existed formed the nucleus of the Exchange. That was one year ago.

DON'T CROWD!

That's a good rule in

Marketing Potatoes

If you crowd the market, you are likely to force prices down.

DISTRIBUTE
SHIPMENTS BOTH AS TO
Time and Destination

DON'T CROWD!

The organization of locals at principal potato-shipping points was begun with the main idea of federating into a central organization which should act as the selling agent for the local associations. The idea spread rapidly, and last summer the Michigan Potato Growers' Exchange was formed with 43 locals affiliated. Since then 12 more locals have organized and affiliated. When the 1918 crop was harvested, the Exchange was completely organized and ready to do the selling for its member associations.

The plan of organization is the co-operative non-profit plan recommended by the United States Bureau of Markets. Each grower, on joining the local association, pays a membership fee of \$10 and gives his collateral note (non-interest-bearing) for \$100, which note is also a guaranty note that he will live up to all agreements made with his association. These local associations and the Exchange are formed without capital stock, as the Michigan laws do not permit the organization of co-operative non-profit associations with capital stock. The membership fees are used as paid-up capital.

The principal provisions of the agreement which each grower makes with his local association are:

To deliver all of his marketable potatoes to his local association, and not to sell or otherwise dispose of his potatoes covered by the agreement except through the association, unless such potatoes are rejected by the association.

To pay the association at least 10 cents per 100 pounds as liquidated damages for all potatoes disposed of otherwise than through the association in cases where a grower fails or refuses to deliver all his potatoes to the association.

The agreement signed by each grower, which agreement is secured by each grower's note for \$100 that he will live up to all its provisions, runs for an indefinite period; but may be cancelled on July 1 of each year on 30 days' notice, at which time the grower may withdraw from the association and his note for \$100

is cancelled. This agreement also obligates the grower to conform to any rules and regulations that may be imposed by the association as regards grading, packing, quality and standardization. Members retain the right to give away or retain for their own use such of their potatoes as they wish.

Each member is also required to report to his local, prior to July 1 each year, the acreage of potatoes he is growing and the probable yield. He is also required to give any other information during the growing season that his association may desire. This requirement enables each local association to know by July 1 the approximate amount of potatoes it will have to market that fall. It also gives the association a check on each grower in ascertaining if he delivers to the association all his potatoes under his agreement. Many regard this as a very stringent provision, but the officers of the Exchange regard it as essential to success. Dorr D. Buell, president of the Exchange, remarked to the writer:

Growers Bound by Agreement

"While this agreement ties the grower up completely to deliver his entire crop to his local association, it is very necessary. Statistics of the United States Bureau of Markets show that more than half the failures of co-operative societies in the United States have been due to lack of loyalty on the part of the members. A few fellows would get together with the best intentions in the world and agree to do certain things in a co-operative way; but they would not bind themselves to do those things; and at the end of the season it would be found that only a few of those who agreed to do certain things had lived up to their agreement.

"In this form of organization we must know how many potatoes we will have to market. We must know the variety and the quality. If we don't bind the growers to deliver all their crop, we might make large contracts, and then, if they refused to deliver to us, we would be un-

able to fill them. In this form of organization the members agree to deliver their potatoes and, if they refuse, their association can collect damages from them."

The \$100 guaranty notes given by members are held by the associations, which may use them as collateral security with which to borrow needed money to carry on the business. This assures each association sufficient reserve funds in case the \$10 membership fund does not meet all expenses.

Each local association either owns or leases its own warehouse, which is equipped for grading, sorting and packing. Since this organization was perfected, several line buyers have quit the field and sold their warehouses to the local associations. Each local association employs a manager. The salaries of managers range from \$100 to \$200 per month, while some associations pay on the per hundred pounds of potatoes handled. All expenses are charged against the shipments. The average total handling and selling expense for the local associations is about 12 cents per 100 pounds. All potatoes are graded and packed in the local warehouses ready for shipment under rules prescribed by the central Exchange, and then held in those warehouses subject to shipping instructions from the central Exchange.

The membership of the central Exchange consists of the local associations. Each local elects a representative to the Exchange. These representatives in turn choose the officers and directors of the Exchange, who direct the business, employ the necessary help and prescribe the necessary rules and regulations.

The Exchange requires an agreement from each local association similar to the agreement required by each local from each member. This agreement binds each local to deliver to the Exchange all the potatoes of its members; it requires a report from each local before July 1 of the acreage and probable yield of all its members; and gives the Exchange absolute supervision over all potato shipments.

Each local pays a membership fee of

\$100 to the Exchange, which serves the same purposes as paid-in capital. Each local also gives the Exchange a negotiable non-interest-bearing note for \$500 to insure that the local will live up to its agreements. These notes may be used as security to borrow money when necessary. In cases where any local declines to deliver to the Exchange all its potatoes, the Exchange may collect damages of ten cents per hundred pounds for the potatoes not delivered. Locals may withdraw from the Exchange on July 1 of each year on 30 days' notice, when the \$500 note will be returned, provided all damages and expenses against the local have been adjusted.

Voting by proxy in either the locals or the Exchange is prohibited. In the locals each member is entitled to one vote, if present. In the Exchange, each representative of each local is entitled to one vote, if present, regardless of the importance or size of the local association.

Cost and Plan of Selling

The cost of operating the Exchange has been met during the past year by a flat charge of eight cents per 100 pounds. Five cents covered all office, handling and selling expenses, two cents were deducted for insurance of potatoes in storage and transit, and one cent for publicity and advertising. On a business of 2,500 cars of 600 bushels each, this eight-cent charge will give the Exchange this year about \$72,000 for general expenses, insurance, and advertising and publicity. Any balance at the end of the year will be prorated to the shippers according to the amounts shipped.

All selling arrangements are made by the Exchange. It finds the market and issues all shipping instructions. For example, its selling plan works this way:

A buyer in Buffalo wants five cars, one in Chicago ten cars, one in Cincinnati three cars. The orders come into the Exchange offices at Cadillac. The sales manager, from the record of production furnished by the growers, knows exactly

how many cars each local has to ship. He knows about how they will grade. He knows the quality.

The sales manager looks over his records and telephones the local manager of this or that association to immediately load and ship a car or two cars to Buffalo. Another local manager will be instructed to ship to Chicago or Cincinnati. This is kept up until all orders are filled and shipping instructions are issued.

All cars are billed f. o. b. the shipping station. The price each car brings is known before it is even loaded. Just as soon as the cars are loaded the local association is advanced 60 per cent of the value of each car through financial arrangements with the bankers at Cadillac. The local managers furnish all necessary information to the Exchange, which bills to the buyers, collects, deducts its eight cents per 100 pounds for handling, and remits the balance to the local associations. The local managers then deduct the local handling expense (average 12 cents per 100 pounds) which includes the manager's pay and all warehouse and loading expenses, and prorates the balance to the shippers. Since all shipments are f. o. b. the cars the shippers do not have to pay any freight charges.

The total handling and selling expense (using the association's average of 12 cents) amounts to only 20 cents per 100 pounds to the grower. No private buyer can operate on that margin. An investigation conducted by the Exchange disclosed that it cost private buyers in its territory last winter at least 50 cents per 100 pounds for selling and handling expense.

The Exchange and affiliated associations have standardized on one variety of potato, Petosky's Golden Russet. This potato is well adapted to that section and is a splendid commercial variety. All potatoes are sold and graded according to the United States grades. Quality is required. The grower who hauls in diseased stock or stock that will not pass

federal inspection has the pleasure of hauling his potatoes home.

The Exchange is planning to advertise Petosky's Golden Russets extensively. "We intend that when the housewife thinks of potatoes she will think of Petosky's Golden Russets," remarked Mr. Buell. Considerable advertising was done in produce and trade publications last winter to acquaint buyers with the Exchange.

Mr. Buell and Mr. Tennant both contend that the greatest value to Exchange members the past year was the protection afforded by the Exchange. This protection assured the growers they would receive exactly the market price. The Exchange was able to force the remaining buyers to pay more nearly what the market would stand, and this influence will be even greater this coming year when the Exchange is better organized.

Most of the Exchange's potatoes were marketed in the southeastern states, as the Exchange found a good market there for its stock. As most growers know, the Chicago market was oversupplied all winter and the market was slow. That was due largely, according to Mr. Tennant, to the fact that hundreds of cars of Minnesota and Wisconsin potatoes poured into that market, day after day, regardless of the condition of the market. The Exchange did not wish to meet such competition and sent its salesmen south in search of a new market. The result was that the Exchange growers received approximately the top Chicago price all winter after all their expenses had been paid.

Associated Activities

The Exchange also has under consideration the manufacture of potato flour. This will enable it to utilize in this manner any surplus stock. The Exchange is also buying co-operatively mill-feeds, fertilizers, potato seed, insecticides and spraying and digging equipment for its members. Considerable money is being saved by buying in large quantities.

Another benefit of this organization is the elimination of speculation. The Exchange knows fairly accurately the production of its members and it keeps close tab on market conditions. Each day it prepares a market letter showing estimates of supply, demand, production and prices which is sent each local manager. This enables every grower to keep in close touch with market conditions.

The marketing activities of the locals and the Exchange are not limited to potatoes. Several of the locals have already begun to handle other farm products, and the Exchange plans to employ an assistant manager soon who will devote all his time to marketing fruits and vegetables. Beans are an important Michigan crop which may easily be marketed co-operatively. Several of the locals are also now shipping livestock co-operatively.

The Exchange also maintains a claim department for the collection and adjustment of claims against purchasers and transportation companies. This department also works for the best conditions of service in transportation, as regards securing of cars, prompt deliveries, just freight rates, and uniform methods of insulation and frost protection in winter shipments.

Michigan potato growers are anxious that this co-operative plan of marketing potatoes will spread to Minnesota and Wisconsin. Why? Because, with sim-

ilar organizations in Minnesota and Wisconsin, the growers of these three states can practically dominate the Middle Western potato markets. These three states last year produced 94,200,000 bushels of potatoes, or 23.5 per cent of the total production of the United States, which was 400,106,000 bushels.

"The Michigan growers anticipate that they will handle at least 35 to 40 per cent of the potato shipments of Michigan this coming year," remarked Mr. Tennant. "In a few years the Exchange should handle at least 50 per cent of the shipments. With similar organizations in Minnesota and Wisconsin, the growers could wield a terrific influence on the markets.

"Just now there is an enormous amount of wasted expense in marketing potatoes. Last winter we found carload after carload of Minnesota potatoes on the Detroit market. These had been re-shipped from Chicago when the market there was oversupplied. With an Exchange in each of the three states, this competition, which in the end cuts the growers' throats, could be avoided by the growers of each state co-operating to keep out of each others' markets. An enormous saving in freight rates alone could be effected. Both Minnesota and Wisconsin are far ahead of Michigan in co-operative enterprises, and I am surprised that these states should have permitted Michigan to take the lead in co-operative potato marketing."

ORGANIZED POTATO MARKETING

From *The Farmer* of Aug. 30, 1919.

Report of Michigan Potato Growers' Exchange Shows What Co-operation Has Meant to Its 6,500 Members

The Michigan Potato Growers' Exchange, the central organization through which 6,500 Michigan farmers are marketing all their potatoes, some of their other products, in addition to buying co-operatively large quantities of their supplies,

completed its first fiscal year July 1. The first annual meeting to review the work of the year was held at Cadillac on July 21-22, which meeting was attended by representatives from all of the affiliated local associations.

The annual reports of the various officers chronicled officially the success of organized co-operative selling and buy-

Why can't
Minnesota
Have a
Potato
Exchange

Read What
Michigan
Did and

Boost for a
Minnesota
Exchange

ing as undertaken by this organization. "The Farmer" presented in its issue of June 21 the story of how this state-wide organization was perfected, how it has grown in importance, and its methods of doing business. This story supplements that data and gives the official statistics on the first year's business, which figures bespeak the success of this undertaking.

The Exchange was organized on August 10, 1918, at a meeting attended by representatives of 33 local co-operative marketing associations and others interested in the potato industry of that state. Thirty-two of these locals affiliated with the Exchange immediately. Since that time 25 other locals have organized and affiliated, giving the Exchange on July 1 a membership of 55 locals, 52 of which were active and shipped during the last year.

The average membership of each local is about 125 farmers, giving the Exchange a membership of approximately 6,500. Fifteen more locals have been organized this summer and have applied for membership in the Exchange. When their applications are accepted the Exchange will then have a membership of 70 locals, comprising about 9,000 individual farmers. Plans are now being made to organize several more locals this fall so that it is confidently expected that by Nov. 1, when the potato shipping season will open in full swing, at least 10,000 Michigan growers will market through the Exchange.

The first potatoes were shipped on September 20, 1918. Up to July 1 a total of 2,118 cars of potatoes were handled in addition to 109 cars of other produce. This represents 20.06 per cent of all the potatoes marketed last year in Michigan, and surveys conducted by the Exchange, through its locals, indicate that of the 1919 harvest the Exchange will handle approximately 3,500 cars, or 35 per cent of the estimated output of Michigan this season.

"Our business has increased by leaps and bounds," remarked Dorr D. Buell, of Elmira, president and general manager

of the Exchange, in making this report "If there was any doubt as to the correctness of the principle of organized marketing I think this report, covering our first year, dispels it. We began shipping almost immediately after organization and our shipments sometimes reached 65 cars daily." The total amount of business done, in dollars, amounted to \$1,808,946.

These potatoes were marketed in 26 states, 186 cities and to 401 customers. The bulk of them went to Ohio, Indiana, Pennsylvania, and New York. Pennsylvania took 609 cars, Ohio 444 cars, Indiana 170 cars, and New York, 150 cars. Only 92 cars were marketed in the home state, Michigan. Georgia, the Carolinas and the Virginias took large shipments as the Exchange was able to find a good market in those sections when the regular northern potato markets were overloaded with potatoes. Wisconsin with one car, Missouri with 25 cars and Illinois with 84 cars, were the only states west of the Indiana-Illinois line, territory that might well be termed Wisconsin and Minnesota territory, which bought of the Exchange.

In fact, the Exchange endeavored to keep out of Chicago territory as the Chicago market was generally well stocked with Minnesota and Wisconsin potatoes and a better market could be found in the East and the South. This is one advantage of this type of marketing as the Exchange can send its salesmen into territories where the market is active and keep out of markets which are already overloaded.

All potatoes were sold on the United States grades, f. o. b. Cadillac, the home office of the Exchange. The potatoes were graded by the managers of the locals, who kept the Exchange advised as to the amount and grade each local had to sell. When the orders reached Cadillac they would be distributed among the locals and shipment made direct from the local points, the freight rates in all cases being based on the rate from Cadillac to the point of destination. Each local has its own ware-

house and its own manager. The average expense of maintaining these locals is about 12 cents per hundred pounds, and the Exchange collects 8 cents per 100 pounds to cover its expenses, making an average total handling expense of about 20 cents per 100 pounds to the farmers. Potatoes were shipped both in sacks and bulk, mostly sacked:

The gross tonnage of all grades handled was 92,326,230 pounds, and the average price per 100 pounds was \$1.627. Of this amount 91,000,025 pounds graded No. 1 under United States grades. The balance 1,326,205 pounds, graded No. 2. The following statistics are interesting as they show the average price received per 100 pounds on the various grades:

No. 1 Grade

	Sacked	Bulk
Prior to Jan. 31.....	\$1.666	\$1.45
February.....	1.452	1.324
March.....	1.455	1.417
April.....	1.924	1.877
May.....	1.981	2.008
June.....	1.165	.876
Average.....	\$1.666	\$1.488

No. 2 Grade

	Sacked	Bulk
Prior to Jan. 31.....	\$.898	\$.789
February.....	.628	.....
March.....	.710	.7026
April.....	.751	.....
May.....	1.102	.....
June.....	551	.....
Average.....	\$.824	\$.7809

Average per 100, all grades, \$1.627.

Officers of the Exchange contend that they were not only able to secure prices equal to and above the Chicago market for Exchange members, but also that the Exchange was able to benefit very materially growers in Michigan who did not belong to the exchange but who sold to the regular buyers.

"This was due to the fact that we compelled the buyers to cut their profits and give the producer a larger share of the dollar," remarked Mr. Buell. "They had to do this to stay in business. Otherwise all the growers would belong to the Exchange, and the buyers could not buy any potatoes as our members are compelled to sell all their potatoes through the Exchange. The co-operative system of selling insures the grower that he will receive all his crop is worth at the time it is sold, less the handling expenses. The dealers' profits and the dealers' often extravagant handling expenses are eliminated. Thus when we speak of getting the Chicago top price for our stock we mean that the grower gets that price, less the local association's, and the Exchange's expense of handling which averages about 20 cents per 100 pounds."

In discussing the effect the Exchange has had on the Michigan market, G. E. Prater, Jr., sales manager of the Exchange, reported at the annual meeting:

"During the past season the potato dealers' margin, as exhibited by government bulletins, was \$0.2724 per 100 pounds in Michigan. Last year (before the Exchange was organized) their margin was \$0.4871, evidently a difference this year of \$0.2147 in the dealer's religion as exhibited by his liberality toward the farmers, or \$1,850,714 more money in the Michigan potato farmers' pockets. This margin, remember, applies to all of Michigan, but the facts are even more striking in Exchange territory.

Members Save Over \$250,000

"The dealers' margin, as exhibited by the same bulletins, this year was only \$0.1922 in Exchange territory, clearly showing the difference of \$0.2949 this season as compared with last season, before the farmers organized. This means \$253,908.90 more to our members than they would have had, had not other competition (Exchange competition) caused the dealers in Exchange territory to pay the last limit the market would warrant.

"By way of comparative profits, the expense last season after deducting 32 cents per 100 pounds—25 cents for sacks and 7 cents for labor—left the dealer \$0.167 net profit to himself, while this season, with Exchange competition, and a cost of 18 cents for sacks and 8 cents for labor, he had a profit of \$0.0124, covering risk, actual loss, etc. Yet, granting that he made this modest profit, careful comparison of these figures show that this season it was necessary for the dealer to handle 33 cars in order to assemble the same profits he received on one last year, before the Exchange entered the field."

While the Exchange was organized primarily to market potatoes for its members it is also handling other produce. During the year 43 cars of onions, 23 of hay, 12 of beans, 8 of rye, 7 of apples, 4 of cabbage, 1 of celery, 6 of buckwheat, 3 of turnips, 1 of oats and 1 of peas were marketed. These cars were handled through the locals the same as potatoes. The possibilities for marketing all products of the farm are such that the Exchange has now created a special depart-

ment with a special sales and purchasing agent who will attend to the marketing of all products, except potatoes, and to the purchase of supplies co-operatively. Sales of products other than potatoes reached \$177,886 during the first six months this selling was done.

Considerable co-operative buying was done for members at an enormous saving, when considered in the aggregate. Total purchases amounted to \$668,836 and consisted mainly of bags, spray material, seeds, twine, coal, feed, and farm machinery. The charges for buying and handling were made as low as was considered good business. The biggest savings were made because of the ability to buy in large quantities. On purchases H. A. Arnold, manager of this department, made the following report:

"On 26,000 pounds of Paris green, a saving of 9 cents per pound; 28,000 pounds of arsenate of lead, a saving of 5 cents a pound; 36,000 pounds of blue vitriol, a saving of 3 cents per pound; 600,000 potato sacks, a saving of \$5 per 1,000."

A POTATO GROWERS EXCHANGE FOR MINNESOTA

S. B. CLELAND, UNIVERSITY FARM, ST. PAUL

A Potato Marketing Exchange, for the co-operative marketing of the potatoes of Minnesota on a large scale, is made a possibility of the near future as a result of action taken at the annual meeting of the Minnesota Potato Growers' Association at Moorhead, November 7th.

The situation up to the time of writing this is as follows:

The State Department of Agriculture, after a careful study of the methods and results of the Michigan Potato Growers' Exchange, issued a statement in September 1919, inviting all potato growers associations and Farm Bureaus to send accredited delegates to the Moorhead meeting for the purpose of considering the formation of such an exchange, and if found desirable, of taking action to start

one. The Department also had prepared and circulated a constitution and by-laws of a central exchange and of a local co-operative potato shipping association.

At the Moorhead meeting delegates were present from potato associations or Farm Bureaus of the following counties:

Anoka	Koochiching
Becker	Lake
Beltrami	Morrison
Chisago	Norman
Clay	Ottertail
Clearwater	Pine
Isanti	Polk
Itasca	Red Lake
Kanabec	St. Louis
Kittson	Wadena

On the program of the Potato Growers' Association meeting were D. D. Buell,

President and General Manager of the Michigan Potato Growers' Exchange, and H. S. Tennant, representative of the U. S. Bureau of Markets and the man largely responsible for the organization of the Michigan Exchange. Both of these men gave clear, straightforward statements of the development and operation of the movement in Michigan.

Following these talks, and after thorough discussion the representatives from the various counties chose a chairman, and a temporary committee was appointed to outline a plan of action in getting organized. The members of this committee were nominated by the delegates from the various potato growing districts, who drew off in groups for the purpose. This committee brought in the following report which was adopted:

Your Temporary Committee recommends the following procedure leading to the organization of the Minnesota Potato Growers' Exchange.

1. That a temporary Board of Directors of seven members be elected to formulate and develop a recommended plan of organization.

2. That this temporary Board of Directors elect a temporary president and temporary Vice President from among its members.

3. That the current expenses of the temporary Board of Directors be submitted to the permanent organization for reimbursement.

4. That this above Board of Directors call further conference when plan of organization is ready to submit. These plans having previously been submitted to the various Potato Organizations of the state for consideration.

5. That Hugh J. Hughes of the State Department of Agriculture act as temporary Secretary.

6. That the temporary Board of Directors secure assistance of the U. S. Bureau of Markets, the State Department of Agriculture, and also the co-operation of the Extension Division of the University Department of Agriculture, and the State Leader of County Agents, and the various Farm Bureaus and their County Agents.

7. That the following men be considered as possible members of the above temporary Board of Directors:

H. B. Plummer, Hawley
 Ludvig Mosbaek, Askov
 H. M. Mory, Motley
 W. F. Hammegren, Harris
 E. P. Nauertz, Little Falls
 E. L. Ferguson, Bethel
 H. C. Hanson, Barnum
 R. C. Madson, Detroit

Respectfully submitted,

A. W. Aamodt, Chairman of Committee
 E. P. Nauertz
 H. L. Kobler
 Ludvig Mosbaek
 P. E. Clement

The Temporary Board of Directors called for was elected as follows:

Name	Town	County	Section
H. B. Plummer	Hawley	Clay	Red River Valley
P. K. Lomen	Beltrami	Polk	Red River Valley
W. F. Hammegren	Harris	Chisago	East
E. P. Nauertz	Little Falls	Morrison	North Central
A. M. Sisler	Grand Rapids	Itasca	Northeast
Ludvig Mosbaek	Askov	Pine	Northeast
E. L. Ferguson	Bethel	Anoka	Twin City.

Subsequently Mr. Lomen and Mr. Ferguson resigned, the former because of having left the state and the latter because of ill health. Mr. C. M. Davidson of Climax, Polk County, was appointed in Mr. Loman's place, and Mr. of was appointed in Mr. Ferguson's place.

The committee met to organize at

Moorhead following the Potato Growers' meeting, and met again the following week at Duluth. The two days were spent in studying the constitution and by-laws and a revised draft was prepared for the use of a central exchange. An organization meeting will be held, to be attended by delegates of the potato shipping associations, such a meeting to be held during January or February, 1920.

ARTICLES OF INCORPORATION AND BY-LAWS
 for a
Co-operative Potato and Produce Local Shipping Association
BY STATE DEPARTMENT OF AGRICULTURE
 State Capitol Building
St. Paul, Minnesota

These by-laws should be regarded as merely suggestive and may be changed to meet the individual needs of the Association.

ARTICLES OF INCORPORATION
 of the

PRODUCE SHIPPING ASSOCIATION

of..... Minnesota

We, the undersigned, residents of County, State of Minnesota, do hereby associate ourselves together for the purpose of becoming incorporated as a co-operative association under the provisions of Chapter Three Hundred and Eighty-two (382) of the Revised Laws of Minnesota, 1919, all the acts amendatory thereto and supplementary thereto, and to that end we do hereby adopt and sign the following articles of incorporation:

ARTICLE I

(Name and Nature of Business)

The name of this corporation shall be the.....

The general nature of its business shall be to encourage better and more economical methods of production; to secure better results in grading, handling, and marketing the products of its members; to buy supplies in a co-operative way; to rent, buy, build, own, sell and control such buildings and other real estate and personal property as may be needed in the conduct of its operation.

This corporation shall, also, have power to affiliate and to co-operate, by membership or otherwise, with any other co-operative association; to subscribe for and invest all or any part of its special reserve hereinafter provided in the Capital Stock of any other co-operative association. It shall have power to do

anything and everything, not inconsistent with law, which is necessary or desirable to accomplish the effects and purposes herein stated.

ARTICLE II
 (Place of Business)

The principal place of transacting business of this corporation shall be in the.....

..... County of..... Mi nesota.

ARTICLE III

(Period of Commencement and Duration)

The time of commencing business for this corporation shall be..... 19....., and the period for its duration shall be thirty years.

ARTICLE IV
 (Names and Residences of Incorporators)

The names and places of residence of the persons forming this corporation are:
 of.....
 of.....
 of.....

ARTICLE V
 (Management)

The management of this corporation shall be vested in a Board of Directors composed of.....¹members. The names and addresses of the first board of directors are.....

Officers of this corporation shall be a president, vice president and secretary-treasurer², elected by and from the Board of Directors.

The officers and directors elected at the time of organization shall hold office until the next annual meeting which shall be held on the..... of.....

ARTICLE VI (Capital Stock)

The amount of capital stock of this corporation shall be
which shall be paid in money or in property or both, in such manner, at such times, and in such amounts as the board of directors shall order. The capital stock shall be divided into
shares of the par value of
each.

ARTICLE VII (Indebtedness)

The amount of indebtedness³ that may be incurred by or in behalf of this association shall at no time exceed the amount of the paid up capital stock of the association.

ARTICLE VIII

These articles may be amended in the manner provided by law.

In testimony whereof we have hereunto set our hands, this
day of 19.....

Enter names on separate lines.
Signed, Sealed and Delivered
in Presence of:

¹ The law specifies that there must be at least five (5) Directors, otherwise, the number is entirely optional. Seven (7) or nine (9) is a desirable number in most cases.

² An Association may desire to have four officers, a President, Vice-President, Secretary and Treasurer.

³ We are asking the Attorney-General for an explanation of this section of the law.

Outline of By-Laws

ARTICLE I

Meetings

- Sec. 1. Annual meetings.
- Sec. 2. Notice of meetings.
- Sec. 3. Special meetings.
- Sec. 4. Presiding officer.
- Sec. 5. Voting.
- Sec. 6. Quorum.
- Sec. 7. Meeting of Board of Directors.
- Sec. 8. Special meetings of Board of Directors.
- Sec. 9. Business for special meetings.
- Sec. 10. Order of business.

ARTICLE II

Membership

- Sec. 1. Qualifications.

- Sec. 2. Contracts and Agreements—
 - a. Form of contract.
 - b. Duration of contract.
 - c. Liquidated damages.

- Sec. 3. Rights and duties.

- Sec. 4. Termination.

- Sec. 5. Restrictions.

ARTICLE III

Directors and Officers

- Sec. 1. Election of directors.
- Sec. 2. Election of officers.
- Sec. 3. Vacancies.
- Sec. 4. Compensation.
- Sec. 5. Removal.

ARTICLE IV

Duties and Powers of Directors

- Sec. 1. Management of business.
- Sec. 2. Employment of manager.
- Sec. 3. Bonds.
- Sec. 4. Audits.

ARTICLE V

Duties of Officers

- Sec. 1. President.
- Sec. 2. Vice-President.
- Sec. 3. Secretary-Treasurer.

ARTICLE VI

Duties of Manager

- Sec. 1. In general.
- Sec. 2. Marketing.
- Sec. 3. Employees.

ARTICLE VII

Financing (Stock)

- Sec. 1. Certificates.
- Sec. 2. Transfers.
- Sec. 3. Assessability.
- Sec. 4. Treasury Stock.

ARTICLE VIII

Business Practice (Expenses and Payments)

- Sec. 1. Payments, when made.
- Sec. 2. Returns to patrons.
- Sec. 3. Deductions made by Association.
 - a. For surplus reserve.
 - b. For current operating expenses.
 - c. For accrued operating expenses.
 - d. For dividend on stock.
 - e. For miscellaneous purposes.
- Sec. 4. Returns to non-members.

Sec. 5. Distribution of remaining surplus.

Sec. 6. Purchasing supplies.

ARTICLE IX

Sundry Provisions

Sec. 1. Fiscal year.

Sec. 2. Amendments.

BY-LAWS

of the

CO-OPERATIVE POTATO & PRODUCE SHIPPING ASSOCIATION

of Minnesota.

ARTICLE I

(Meetings)

Section 1. The annual meeting of the Association¹ shall be held on the of of each year.

Sec. 2. Ten (10) days' notice shall be given of all meetings of the shareholders by publishing notice thereof in the local paper, and by circular notice mailed to each shareholder.

Sec. 3. The President shall call a special meeting upon the majority vote of the directors or the written request of ten (10) per cent of the stockholders. The notice for such special meeting shall state the time, place and purpose as provided by law.

Sec. 4. The President of the Association shall preside at all meetings of the shareholders, and shall cast the deciding vote in all cases of a tie.

Sec. 5. No stockholder shall be allowed to vote by proxy. Any stockholder may vote by mail as well as in person at any regular or special meeting of the stockholders, provided that such stockholder shall have received a copy of the exact text of the motion or resolution or amendment, and that a copy of the same be forwarded with and attached to the vote as mailed by absent stockholders. All members voting by mail shall be counted as present in determining a quorum for the consideration of a specific question. All officers shall be elected by ballot.

Sec. 6. A majority of stockholders shall constitute a quorum for the transaction of business, when the total number of stockholders does not exceed one hundred (100), and twenty-five (25) per cent of the total number of stockholders in all other cases, provided the total number present shall not be less than fifty (50).

Sec. 7. The Board of Directors shall hold at least one regular meeting each month, the exact time and place to be determined by the President.

Sec. 8. Special meetings of the Board of Directors may be called by the President or any of said Board. Each member of the Board of Directors shall be duly notified of all such meetings.

Sec. 9. No business except that mentioned in call for special meeting of the Board of Directors, shall receive final action at said meeting. Directors shall constitute a quorum at all meetings of the Board, and a majority vote of the members present shall decide all questions except the transfer of grounds and buildings which shall require the presence of the whole Board and a majority vote thereof².

Sec. 10. (Order of business).

The order of business at the annual meeting, and so far as possible at all other meetings of the members, shall be:

- (1) Calling of roll.
- (2) Proof of the notice of meeting.
- (3) Reading and disposal of all unapproved minutes.
- (4) Annual reports of officers and committees.
- (5) Election of Directors.
- (6) Unfinished business.
- (7) New business.
- (8) Adjournment.

ARTICLE II

(Membership)

Section 1. (Qualifications).

Any producer of farm products, including both landlord and tenant in tenancies on shares, in territory tributary to the center served by this Association may

become a member of the Association by agreeing to comply with the requirements of these By-Laws and by becoming the owner of one, but not more than....., shares of stock of the Association. Application for stock must be submitted to and approved by the Board of Directors.

This section shall not prevent the Board of Directors, at their discretion, from accepting for membership any person who may be a user of any of the products and supplies handled by the Association and patron or prospective patron of the Association.

This section shall not prevent the Board of Directors, at their discretion, from accepting for membership any person who has special³ qualifications for acting as secretary-treasurer of this Association; provided that his membership shall continue only during the period that he is acting as secretary-treasurer.

Sec. 2. (Contracts and Agreements).

(a) (Form of Contracts). Each grower upon becoming a member of this Association shall enter into a contract with the Association in the form required by the Board of Directors. Said contract shall specify, among other things, that the grower appoints the Association his agent for the purpose of handling, grading, storing, and marketing all the potatoes and other products delivered to it and that he binds himself to deliver to this Association such products at such time and place as may be agreed upon by said local and this Association.

(b) (Duration of Contract). The period of said contract shall extend indefinitely, provided that a grower wishing to withdraw his membership may cancel his contract on the first of July of any year upon giving a thirty (30) days notice to the Association.

(c) (Liquidated Damages). Any grower who fails to live up to his agreement or fails or refuses to deliver to the Association for sale the pledged products, shall pay to the Association as liquidated damages the sum of ten (10) cents for each hundred weight of potatoes and

other produce not delivered by it; said sum may be deducted from any money in the possession of the Association due to said grower. Furthermore, such claim shall be a lien upon the grower's stock in the Association.

Sec. 3. (Rights and Duties).

Each grower agrees upon accepting membership in this Association to market all of his produce, of a kind handled by the Association, through the Association.⁴ This agreement shall not be construed to prohibit any member from selling or shipping, either locally or otherwise, produce, to actual consumers in less than carload lots.

If any member receives a bid for his produce from an outside buyer or dealer, at a higher price than the Association is paying or can secure for him, he shall refer such offer to the Association to be filled from said member's deliveries to it.

On or before.....of each year each member shall report to the Association the acreage of products to be grown by him that year. During the growing season each member shall furnish such information concerning his crops, as may be requested by the Manager.

All products grown by the members for sale through the Association either shall be graded and packed on the growers' premises, in accordance with the rules of the Association, subject to such inspection as shall be established by the Board of Directors, or shall be delivered to the Association, as directed by the Manager, in prime condition for grading, packing, and shipping. If any produce is not of good quality and in good condition for shipping, such produce shall be sorted and prepared for shipment at the expense of the grower.

Sec. 4. (Terminations).

At any time, if a member shall cease to be a producer of farm products, or shall remove from the territory tributary to the center served by this Association, or shall, for a period of two (2) consecutive years, fail to patronize it or shall fail to comply with the requirements of these

By-Laws, the Association may elect to purchase his shares of stock and cancel his membership upon tender to him of the par value or market price if higher, of his shares together with any interest or refunds due and unpaid, less any indebtedness then due the Association. Such shares shall then become treasury stock of the Association.

Sec. 5. (Restrictions).

No member shall own more than shares of the capital stock of the Association at any one time, and no member shall have more than one (1) vote, regardless of the number of shares owned.

Every member upon uniting with this association, agrees that in case he desires to dispose of his shares of stock in the Association, he shall give the Association the first opportunity to purchase it. If the Association waives its rights of purchase by failure to act within thirty (30) days, a stockholder may sell the stock to anyone eligible to membership.

ARTICLE III

(Directors and Officers)

Section 1. (Election of Directors).

Directors of the Association shall be members of the Association and shall be elected by the members in annual meeting assembled. The directors shall be elected at the first annual meeting, to serve for one (1) year, to serve for two (2) years, and to serve for three (3) years, so that thereafter, there shall be elected each year to serve for a term of three (3) years. The elections shall be by ballot and each member of record shall be entitled to cast one vote, and only one vote, for each Director to be elected.

Sec. 2. (Election of Officers).

The Board of Directors shall meet within days after the first election, and after each annual election and shall elect by ballot a President and a Vice-President and a Secretary-Treasurer (or a Secretary and Treasurer) who may or may not be a member or members of the Association. Directors and officers shall hold office until their successors shall

have been elected and qualified and shall enter upon the discharge of their duties.

Sec. 3. (Vacancies).

Any vacancy in the Board of Directors shall be filled for the unexpired term at any annual meeting or at any special meeting called for the purpose in the manner provided for original election of Directors. If any Director shall cease to be a member his office shall be declared vacant.

Sec. 4. (Compensation).

The compensation, if any, of the Directors and officers, other than the Manager, shall be determined by the members of the Association at any regular or special meeting of the Association.

Sec. 5. (Removal).

Any Director of the Association may, for cause, at any annual or at any special meeting called for the purpose, at which a majority of the members shall be present, be removed from office by vote of not less than two-thirds of the members present. Such Director shall be informed in writing of the charges preferred against him at least ten (10) days before such meeting, and at such meeting shall have an opportunity to be heard in person, or by counsel and by witnesses thereto.

ARTICLE IV

(Duties and Powers of Directors)

Section 1. (Management of Business).

The Board of Directors shall manage the business and the affairs of the Association, and make all necessary rules and regulations not inconsistent with law or with these By-Laws, for the management of the business and the guidance of the officers, employees and agents of the Association.

Sec. 2. (Employment of Manager).

The Board of Directors shall have the power to employ and to dismiss a Business Manager, and to fix his compensation.

Sec. 3. (Bonds for Manager and Officers).

The Board of Directors shall require the Manager and all other officers, agents, and employees charged by the Association with responsibility for the custody

of any of its funds or property to give bond for the faithful performance of their official duties. Such bond shall be furnished by a responsible bonding company, or other surety suitable to the Board of Directors, and the cost thereof shall be paid by the Association.

Sec. 4. (Audits).

The Board of Directors shall audit all accounts at their regular meetings at least four (4) times a year, and shall have the books audited at least once a year by an expert and qualified accountant, who is not a stockholder of the Company, such audit to take place during the thirty (30) days preceding the annual meeting.

ARTICLE V

(Duties of Officers)

Section 1. The President shall:

a. Preside over all meetings of the Association and of the Board of Directors. Be ex-officio member of all committees.

b. Sign as President, with the Secretary-Treasurer, all notes, deeds, and conveyance of real estate, as well as all certificates of stock of the Association.

Sec. 2. In the absence or disability of the President the Vice-President shall preside and perform the duties of the President.

Sec. 3.⁵ The Secretary-Treasurer shall:

a. Keep a complete record of all meetings of the Association and of the Board of Directors.

b. Sign as Secretary-Treasurer, with the President, all notes, deeds, and other instruments on behalf of the Association.

c. Serve all notices required by law and by these By-Laws.

d. Receive and disburse all funds and be the custodian of all property of this Association.

e. Keep a complete record of all business of the Association. Make and submit at the annual meeting of the stockholders a complete and detailed report of the current year's business giving the total amount of each kind of

produce shipped and the gross amount received for each kind; the operating expenses in detail, and an itemized statement of all resources and liabilities, both at the beginning and at the end of the year. He shall submit such monthly reports as shall be required by the Board of Directors.

f. Be the chief accounting officer of the Association. He shall employ or cause to be employed in the Association an adequate bookkeeping system based on the principles of double-entry and approved by the State Department of Agriculture.

g. Perform such other duties as may be required of him by the Association or the Board of Directors.

ARTICLE VI

(Duties of Manager)

Section 1. (In General).

The Manager shall be at the yard, unless he shall have secured a competent substitute, on all days that shipments are to be made, to inspect, receive, weigh, mark, and load the produce. If so ordered by the Board of Directors, he shall receive all payments for stock sold and make disposition of such payments in accordance with Article VIII hereof. He shall keep a complete record of all shipments made and shall furnish to each shipper a statement showing the net weight, the price received and expenses for each shipment. If so directed, he shall keep all accounts of the Association for which he shall be immediately responsible to the Secretary who is the Chief Accounting officer.

Sec. 2. (Production and Marketing).

Subject to the order of the Board of Directors, and the By-Laws and Rules of the Association, the Manager shall have entire charge of the marketing of all the products handled by the Association. He shall secure information as to production and marketing conditions and shall furnish the same to the members on request.

He shall encourage the production of the varieties of produce best adapted to the producing area and in greatest de-

mand by the trade. He shall, as may be required by the Board of Directors, conduct packing schools, in order that growers may become trained in the best methods of grading, packing, and labeling their products. He shall have charge of the grading, packing and inspection of all produce handled by the Association and shall have control of the brands and labels and their use on such products in accordance with the Rules of the Association.

Sec. 3. (Employees).

The Manager shall employ and discharge all employees, agents, and laborers.

ARTICLE VII

Finance (Capital Stock)

Section 1. (Certificates).

Certificates of stock shall be issued to each holder of full-paid stock. Each certificate shall state the par value of the stock, the number of shares represented, the name of the person to whom issued, and shall bear the name of the President and Secretary of the Association and be numbered and issued in numerical order from the stock certificate book. A record of each certificate shall be kept on the stub thereof.

Sec. 2. (Stock Transfers).

Transfers of stock shall be made only on the books of the Association and before a new certificate is issued the old certificate must be surrendered for cancellation. No stock shall be transferred unless any and all indebtedness owing to the Association by the member shall first be paid. The stock books of the Association shall be closed for transfer ten (10) days before the annual membership meeting and ten (10) days before the time set for payment of interest and patronage refunds.

Sec. 3. (Assessability).⁶

Stock shall be assessable to twenty (20) per cent of its par value, but no assessment shall be made to exceed five (5) per cent of the par value of the stock at any one time. No assessment shall be levied except at a regular or special meeting of the stockholders, notice of which shall have been given in writing to each stock-

holder ten (10) days prior to such regular or special meeting.

Sec. 4. (Treasury Stock).

The treasury stock of this Association shall consist of such issued and outstanding stock of the Association as may be donated to it or otherwise be acquired by it, and shall be held subject to disposal by the Board of Directors.

ARTICLE VIII

(Business Practice) or (Expenses and Payments)

Section 1. (Payments, When Made).⁷

Growers shall receive payment after each shipment by the Association upon the receipt of the proceeds by the Association or at the end of each pooling period.

Sec. 2. (Returns to Patrons).

In making sales the Association shall pool such produce of the same grade for such periods as it shall decide; and all growers having produce of the same grade and quality shall receive exactly the same price. Returns to growers shall be on the basis of the average price for each grade during the pooling period. The total amount available for payment to the growers shall be the gross proceeds to the Association from a shipment, as shown by the account sales, less the deductions provided for in Section 3 hereof, which deductions may be made in the discretion of the Board of Directors, as a fixed percentage charge upon the returns for produce sold, or as a fixed charge per one hundred pounds or per ton of produce shipped.

Sec. 3. (Deductions).

The charges⁸ provided for in Section 2 shall be adequate to cover the following items:

a. (For Surplus Reserve).⁹ The amount of this deduction shall be determined by the Board of Directors and shall be continued until the earnings thus retained in the business shall amount to at least thirty (30) per cent of the paid up capital stock. This surplus shall be employed in the business for a legitimate purpose.

b. (For Current Operation Expenses).

c. (For Accrued Operating¹⁰ Expenses). This deduction shall be adequate to cover such items of expense as wages and salaries, insurance,¹¹ taxes, repairs, renewals and replacements, depreciation, interest and other items.

d. (For Dividends on Stock). This deduction shall be sufficient to pay a rate of.....¹² per cent on stock.

e. (Miscellaneous). This deduction shall be for any other purpose, at the discretion of the Board of Directors.

Sec. 4. (Returns to Non-Members).

This Association may handle the produce of non-members, provided that in addition to the deductions to be made by the Association as specified in Section 3 hereof, the Association shall charge..... per hundred for all such produce handled. Said charge shall be considered just recompense to the Association for handling the uncertain business of non-members.

Sec. 5. (Distribution of Remaining Surplus).

Any surplus at the end of the fiscal year resulting from an over estimation of expenses during the year shall be distributed on the basis of the quantity of produce sold through the Association.

Sec. 6. (Supplies).

If the Board of Directors shall so direct, the Association may purchase supplies to be sold to members and non-members. The Manager shall handle such supplies upon a margin adequate to cover all expenses, and the items as indicated in Section 3 hereof, chargeable against such operations. Any surplus remaining at the end of the year from this source shall be distributed to members and non-members on the basis of purchase from the Association. Non-members shall receive such refund at one-half the rate paid members; provided, that the amount due each non-member, or sufficient part thereof, be first credited to his account in payment for..... shares of stock of the Association.

ARTICLE IX
(Sundry Provisions)

Section 1. (Fiscal Year).

The fiscal year of this Association shall commence....., and end on the..... of the following

Sec. 2. (Amendments).

These By-Laws may be amended, repealed, altered in whole or in part, at any regular meeting of the members, or at any special meeting, when such action has been duly announced in the call, by a two-thirds vote of the members present and voting, including those voting by mail.

¹ This corporation shall be referred to in these By-Laws as the Association.

² It might be well to let the stockholders, themselves, decide this important question.

³ A local banker or business man would be valuable in this capacity, if willing to serve.

⁴ A separate grower's contract or pledge to be executed annually might be used. However, it would seem, that membership in the Association ought to imply this obligation.

⁵ If separate Secretary and Treasurer are provided for, Article V should contain another section to specify the duties of the Treasurer. It should contain division (c) of this section and another division as the following: The Treasurer shall render full account to the stockholders, at annual meeting assembled, for all funds or property received and disbursed by him. He shall not pay any money so received or notes and securities held except on written order of the Secretary, unless otherwise ordered by the Directors.

⁶ To make the stock assessable strengthens the credit of the Association. This is not a universal feature, however.

⁷ Another method of payment to growers may be adopted, of course. Such a method might be a different type of pooling arrangement or outright purchase from shippers. The latter method does not seem to be as feasible in handling produce as in handling grain, in which field it is generally employed. The marketing risk that cannot be shifted in the produce business is most satisfactorily in the first instance borne by the growers, themselves. In case a bill of exchange is drawn against a shipment the Association can safely advance to the growers at least sixty (60) per cent of the selling price.

⁸ It is thought desirable to set forth explicitly in the By-Laws an outline for a sound business practice. Hence, it is suggested that instead of providing merely that a certain charge shall be made to cover all expenses and financial necessities, the By-Laws should set forth definitely the nature of the blanket charge or deduction to be made by the Association.

⁹ The law requires that at least ten (10) per cent of annual net earnings shall be retained in the business until this surplus shall amount to at least thirty (30) per cent of the paid-up capital stock. As the law is drawn, the application of this provision of it to a produce shipping association, conducting its operations on a pooling basis, is uncertain. Such an association may conduct its business in such a manner as to have no net earnings, within the accounting meaning of this phrase. However, some surplus puts any association upon a sounder financial basis; consequently, it should be provided for. The Board of Directors may provide for such a surplus by retaining in the business

a certain per cent of sales, or of the net amount available for return to the growers for instance, it might decide to retain one-tenth (1-10) of one (1) per cent of gross returns to the Association less all operating expenses. Of course, this surplus is available for any legitimate employment within the business. It is not in any sense a separate fund to be devoted to a specific purpose.

¹⁰ In order to know and to show the nature and amount of each specific expense item, an account should be set up for each kind of expense. It is suggested that these items be handled on the

books by debiting each specific account with such expense chargeable to it and crediting the total of all such accrued items to an account called "Reserve for Accrued Expense."

¹¹ One important item of expense here is loss of produce in shipment that cannot be collected from the railroad. Against such contingencies a reserve should be provided.

¹² Eight (8) per cent is the legal maximum. When the stock is widely held in small amounts and has a small par value the policy of paying no dividend on stock does no great injustice to anyone.

POTATO PLOT WORK IN BENTON COUNTY--1918

W. E. WATSON, FARMINGTON, MINN.

The potato industry in Benton County, as in most of the counties in the state, is hampered to a great extent by the very prevalent handicap of many and mixed varieties. Potatoes of several distinct varieties and types in the one load, bring a lower price because the housewife in whatever part of the United States she happens to be does not want those various types and varieties of potatoes in the same pot when preparing for dinner. Therefore, one of the first things required to secure the best market for our potatoes is to get clean varietal strains.

Again, when one farmer improves and cleans his stock and his neighbor loads into the same car a load of inferior stock or good stock of any other variety, it makes inferior stock of the entire carload and they go on the market as such.

These facts make it imperative that the Farm Bureau in potato communities should use its influence to clean the seed stock of the county and to assist in standardizing the varieties for the various markets of the county.

In the spring of 1918 the Farm Bureau working in co-operation with Mr. A. G. Tolaas, State Potato Specialist, and nineteen men put in seed plots for seed improvement. The seed for their plots was

selected from the seed stock of the farmer. In selecting this seed varietal purity and type were particularly watched. This seed was planted in plots separate from the balance of the field.

When the potatoes were in bloom the plot was rogued by A. G. Tolaas working with County Agent Watson and the owner of the field. All varietal mixtures were removed, also all diseased or weak plants, leaving only the plants that looked as though they would produce desirable seed.

In the fall at digging time the owners were assisted in selecting enough seed for a plot next year, using only seed from the highest producing hills. The balance of the potatoes from the plot were used for seed in the main field. By following this method the varietal mixtures may be completely cleaned out and it will be a great help in getting rid of black leg and black scurf.

Twelve of the nineteen men starting, completed the work and hill selected. The men cleaning their seed will be the ones to furnish their neighbors with pure seed in the future. Fifty plots were put in in 1919. The following table shows the results of the plots:

No.	Variety	Quality in Spring	Improvement	Increase in Yield
1	N. Y.	Fair.....	Cleaner seed.....	Same
28	N. Y.	All seed that had gone through the sorter.....	Plot was dropped before digging time.....	
3	G. M.	Very good. Mr. Mader has practiced selection for years and has a very good stock on hand. The local buyers handle it for Cobblers but Mr. A. G. Tolaas of University Farm identifies it as Green Mountains.....	None.....	Yield some less
4*	E. O	Fair.....	Cleaner.....	Same
5*	N. Y.	Mixed three varieties.....	Better quality, pure seed.....	Same
6†	N. Y.	Good.....	Freer from disease, cleaner seed. He is going to change varieties to Cobblers.....	Same
7*	N. Y.	Fair.....	Cleaner but was quite clean in spring.....	45 bu.
8*	N. Y.	Fair.....	Better quality and pure.....	Same
9*	N. Y.	Fair but badly mixed.....	Clean seed of improved quality.....	10 bu.
10*	N. Y.	Poor, badly mixed.....	Much better quality, clean seed.....	10 bu.
11†	E. O.	Very good.....	About same.....	Same
12	N. Y.	Good.....	Cleaner. He is going to change seed and follow the plot with them.....	
13*	Triumph	Very good.....	About same.....	Same
14*	Cobbler	Mixed badly.....	Better and clean.....	Same
15*	Cobbler	Mixed badly.....	Better quality and clean.....	Same
16*	Cobbler	Good but mixed.....	Clean, otherwise same.....	10 bu.
17*	N. Y.	Fair.....	Better quality, absolutely pure....	25 bu.
18*	Burbanks	Very good.....	Same.....	Same
19†	[E. O.]	Good.....	Pure, going to drop plot and take up corn breeding.....	Same
No.	Variety	Quality in Spring	Improvement	Increase in Yield

* Those selected seed for a plot next year from the high producing hills.

† Those so marked did not check for yield.

SUGGESTIONS AS TO WHAT A POTATO GROWER SHOULD DO TO SECURE CERTIFICATION

E. W. SMITH, PARKERS PRAIRIE

My experience as an inspector for the Minnesota Board for Seed Potato Inspection and Certification during the past summer has prompted me to write this brief article in the hope that the few suggestions I have to offer will be of value to those who intend to go into the business of growing certified seed potatoes.

In the first place select the best field you have on the farm and enrich the land by using a clover sod or manure, or if possible, both.

Plow deep, preferably in the fall. In the spring disc and drag this field four or five times before planting time.

Seed to Use.

The seed potatoes should be pure as to variety, true to type and well selected as to size. Four to ten-ounce potatoes suit me the best. Cut the potatoes into two or four pieces making two to two and one-half ounce seed pieces. Handle this seed carefully. Avoid the use of boxes or barrels and do not fill sacks too full. I prefer to use regular potato sacks for the cut seed placing about one bushel in each sack and then keep them away from the direct rays of the sun. All seed potatoes should be treated in corrosive sublimate solution at the rate of $7\frac{1}{2}$ ounces to 50 gallons of water, treating for two hours before the tubers are cut.

Plant carefully from $3\frac{1}{2}$ to 5 inches deep, depending on the nature of the soil.

Cultivation

Start harrowing shortly after planting; going over the field two or three times before the potatoes come up. A person can kill more weeds in one day with a harrow before the potatoes are up than he can in a week with a cultivator after the crop is well along. The first cultivation should be deep and thorough just when the row begins to show enough to follow it. At that time it will do no harm to cover the

row with the dirt from the cultivator shovels, in fact, I believe that it is a good plan to turn the shovels in such a manner as to cover the rows completely. By this method one can get all of the weeds and at the same time loosen up the under soil so as to enable the roots to extend more freely. Right after this severe cultivation hitch onto the harrow and cross harrow the field. This levels the soil and completely eradicates all weeds. Frequent cultivation should follow, gradually working nearer the surface to prevent pruning the roots late in the season. Cultivate late enough and frequently enough to prevent weeds from smothering the potatoes.

I never saw a good crop of potatoes and weeds grow on the same land at the same time, and I have been asked to inspect fields for certification where weeds stood to my waist and so thick that I could hardly see the potato vines. In one field the Canada thistles were two feet high and so thick I could not get through them. Still the grower expected to have his field accepted. Clean and thorough cultivation is essential.

Know Potato Diseases

The grower should inform himself as to the requirements regarding vine diseases, and keep a sharp eye out for them. Many a good field has failed to pass inspection because the owner neglected to follow the rules requiring him to remove all diseased plants before the second inspection.

Bugs and hoppers have been the means of preventing many fields from passing the rules for certification this past season. Therefore, it is up to the grower to keep a watchful eye on his field and to use poison at the right time. Grasshoppers were very bad, especially in the western part of the state and after the wheat harvest they flocked to the green

potato fields and it did not take them many hours to completely strip the foliage and ruin the crop. Therefore, I wish to issue a warning to growers to have the materials for poison bait ready to use at a moment's warning.

In summing up I will say: Select good seed. Treat it for disease. Plant on rich land. Cultivate well and often. Poison

the bugs and the grasshoppers if need be. Rogue out all varietal mixtures and diseased plants. And above all things plant a small seed plot that you can take extra good care of and secure the best of seed for next season's main crop.

This should be the slogan of the potato grower, "A special seed plot every year."

Certified Potatoes

They are—

- ¶ Of prescribed standards of purity.
- ¶ True to type.
- ¶ Vigorous and healthy.
- ¶ Free from disease.

And they sell at better prices for seed than uncertified potatoes.

Make Application Before July 1st
to the Minnesota Board of Seed Potato
Inspection and Certification.

CERTIFIED COBBLER PRODUCTION

By VERNE STEWARD, PRINCETON, MINN.

It has been suggested that the material which follows this introduction might be of general help to those engaged in or planning to engage in certified seed potato production. The context covers in detail the methods of production together with a few general suggestions which may aid in marketing.

I must not forget to add that the more careful methods of production pay. The use of the best seed obtainable pays. The treating of seed pays. Bordeaux spraying gives returns several times the cost of spraying and lastly it may be said that the roguing of seed plots in the case of eating stock production and the roguing of entire fields in the case of seed stock production must soon become a general practice. There is no question but that this also pays.

The project was organized in March, 1919, by Verne Steward immediately following his resignation from the position of County Agricultural Agent of Mille Lacs County. Ten farmers were secured

as associates by Mr. Steward who assumed responsibility for the technical work and supervised the entire project. Full co-operation was given by the Minnesota Experiment Station and to some extent advice was secured from the Wisconsin and Michigan Experiment Stations and of the United States Department of Agriculture.

The seed used was the best that could be secured locally through careful bin inspection with the exception of ten bushels which were purchased for comparison from Duluth, Minn. The Irish Cobbler variety was adopted as standard with a small area given to the (Bliss) Triumph. All seed was hand sorted.

The seed treating box shown above was planned and made by Mr. Steward. It contains two sections with sloping ends so that the potatoes, after being soaked, may be easily removed from the solution with an ordinary scoop. The sections are emptied and refilled alternately. The capacity is 27.5 bushels. On the last day



THE MEN FORMING THE ASSOCIATION

TOP ROW—READING FROM LEFT TO RIGHT: ALBERT HOEHN, ERNEST BYERS, OSCAR STARK, AUGUST GEBERT, VERNE STEWARD. LOWER ROW: ALBERT GEBERT, WALTER MARK, WILLIAM GEBERT, OTTO PRAHL, JOHN WILHELM, FRED HOEHN.



SEED TREATING BOX

of work 275 bushels were treated but the normal capacity per day of ten hours should be given as 200 bushels. Corrosive sublimate was used, formalin not having proven successful for the black scurf or rhizoctonia.

Vigorous plants are necessary for the production of vigorous seed. The year's experience shows that under Minnesota conditions increased yields are obtained by spraying with bordeaux mixture even

in years when early or late blight is not present. The tubers run truer to type. The plants hold green for a longer season. Tip burn injury is reduced.

The sprayer used was the Iron Age, 100 gallon, triple cylinder, three nozzles to each row traction sprayer. The drop nozzles were removed for the first application as the overhead nozzles were considered sufficient while the plants were small.



THE SPRAYER. THE FIELD SHOWN IS THAT OF WILLIAM GEBERT WHO IS HANDLING THE MACHINE.



THE DOPE WAGON

In order to accommodate a large acreage on scattered farms it was necessary to construct a "dope wagon." Two of the lower barrels were used alternately for the stock solutions of blue-stone (Copper sulphate). One barrel was used for stock solutions of slaked stone lime and one for tools and equipment. One elevated barrel was used for the dilute blue-stone and one for the dilute milk of lime previous to the filling of the sprayer. Water was furnished in most cases by means of a

thresherman's water tank although in a few instances it was dipped directly from a stock tank as shown in the picture. To fill the sprayer it was only necessary to back the sprayer to the wagon and turn the two hoses into the strainer bucket. The bucket used was a home-made affair of eight times the capacity of the bucket furnished with the machine.

Even careful hand sorting will not eliminate mixtures from Irish Cobbler seed. Two late white varieties so resemble



THE PICTURE GIVES A GOOD VIEW OF MR. STEWARD'S 20 ACRE IRISH COBBLER FIELD

6



THE PICTURE SHOWS TEN ROWS OF THE TRIUMPH VARIETY ON THE EXTREME LEFT OF THE VEPNE STEWARD FIELD. THE IRISH COBBLERS ON THE RIGHT DO NOT SHOW THE STAND OR VIGOR SHOWN IN THE PREVIOUS PICTURE

this variety that even the most trained eye will miss them. Mixtures and certain diseases must be removed from the fields during the growing season. All the fields in the project were "rogued" twice. The first roguing was at the time of blossoming when foreign and diseased plants were pulled out. The second

roguing took place just before the plants ripened when mixtures were overlooked the first time and the plants which had developed disease during the latter part of the growing season were dug with forks. This careful roguing in keeping with the cultural practices heretofore outlined gives as disease-free and variety-pure seed stock

7



THE FIELD SHOWN IS THAT OF ERNEST BYERS. THE PICTURE WAS TAKEN NOT QUITE TWO MONTHS FROM DATE OF PLANTING. MR. GEORGE T. WHITE, DEPUTY STATE INSPECTOR, IS SHOWN AT THE IMMEDIATE LEFT OF MR. STEWARD.

8



STORAGE WAREHOUSE AT PRINCETON

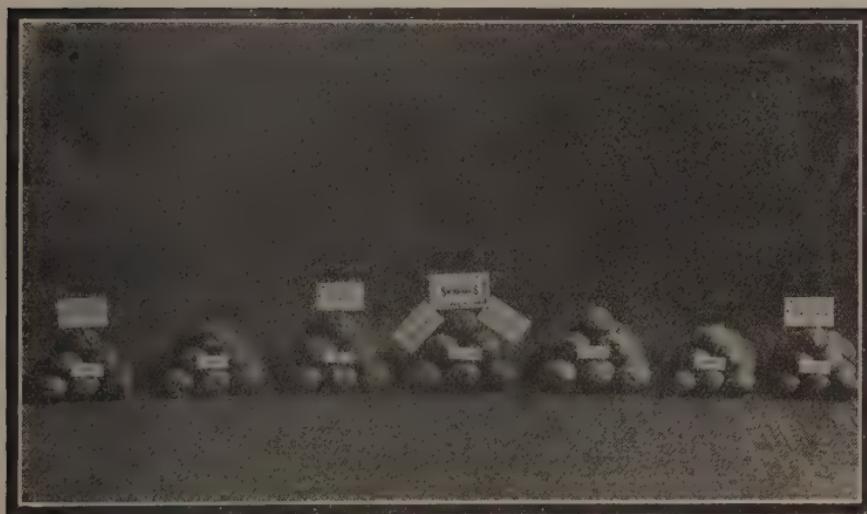
as it is possible to secure. From less than one to as high as six per cent of the plants were removed from the several fields in the two roguings.

The picture shows ten rows of the Triumph variety on the extreme left of the Verne Steward field. The Irish Cobblers on the right do not show the stand or vigor shown in the previous picture. The seed used for a few rows was badly sprouted when obtained in the spring and as a result was weakened. Spindling plants were found, the removal of which cut down the stand. This forcibly calls the attention of the observer to the fact that seed stock must reach the purchaser in good condition. The year of 1919 has been a very bad year for the Triumph variety as both July and August were very dry. In Northern states under very favorable conditions the Triumph will nearly equal the Cobbler but under average conditions the latter variety is much the superior. The increasing demand for the Cobbler on the early eating stock market in the South has been very gratifying to Northern growers. Mosaic disease of Triumphs which has been found in such prevalence everywhere may gradually eliminate the variety.

In Minnesota the potato certification

law provides for three inspections. Certificates are issued where the potatoes meet the required standards. Certification tags must be attached to the containers by the Chief Inspector or a person properly deputized by him. The tags will constitute a seal the breaking of which relieves the Inspection Service of responsibility for the potatoes in the container. Thus the State hopes to avoid the discrediting of its service which must come from unlawful use of ordinary tags. Misuse of the term "certified" and the purposeful or accidental spreading of misinformation concerning certification work is met with everywhere. Persons desiring accurate information should write for circular covering Minnesota law and the rules and regulations governing the growing of potatoes for certification. This circular also covers the misuse of the term "certification" as met with in both the Northern and Southern states.

Proper storage is as necessary as proper production methods. The above warehouse located in Princeton was leased for the project. The potatoes are removed from the fields to the warehouse as soon as they have gone through the sweating stage in covered piles. The warehouse contains a full basement in addition to the



VARIETIES OF POTATOES ENTERED AT STATE FAIR

storage bins on the first floor. The potatoes will be sized and sorted and placed loose in the bins. Shipment will be made at the proper time direct to the purchaser.

In carrying out the project every attempt has been made to determine the needs and to meet the wishes of the persons who will use the seed. To succeed in a seed potato production project full appreciation of the purchaser's problems is necessary. Potato production of any sort is a cold, matter of fact business. Certified seed potatoes must be better seed potatoes. Purchasers can have no time for passing fads.

EDITOR'S NOTE.—The above article and illustrations show the advantages of team work and scientific knowledge applied to farming. Mr.

Steward and his associates have started something new. They are pioneers in a new kind of enterprise. They will probably realize a good profit for their efforts. We hope they will. They deserve it.

We haven't all of the details of this plan but in a general way it is about as follows: The ten potato growers have associated themselves with Mr. Steward for the purpose of producing and selling certified seed potatoes. The growers furnish the land and equipment for growing potatoes; Mr. Steward furnishes the expert knowledge needed for seed selection and treatment, for spraying for diseases, for roguing for purity and diseases, for proper grading and storing and lastly but by no means least, for selling. Certified seed potatoes are similar to purebred registered cattle, especially purebred dairy cattle which in addition to a pedigree have a certificate of health and a record of performance. Certified seed potatoes are first selected for purity and type. Every precaution is taken to keep them free from disease, in fact if this is not done they will not pass the inspection necessary to have them certified. Then they are also selected and bred for high yields. So that one who buys real certified seed is getting something good.

A very large part of all potatoes planted should be certified seed stock. We hope this will be possible in the near future.

DEGENERACY OR RUNNING OUT OF POTATOES

FRED A. KRANTZ, UNIVERSITY FARM

The degeneracy or running out of potato stock is a common phenomenon where soil and climate is unsuitable or where certain diseases as leaf roll, mosaic and curly dwarf are present. Under favorable conditions degeneracy is not apparent and growers are able to use their own seed stock for years without any loss of vigor. The same is true of varieties. Age does not impair their vigor and productiveness when grown in favorable

The term degeneracy usually refers to the loss of vigor in a variety, though it is frequently used to indicate a change of tuber characters away from the varietal type. The fact that the two types are often found associated together has led to the erroneous belief that they are correlated. The tubers of a weak plant are more easily modified by adverse conditions than those of a strong healthy plant, and for this reason certain abnor-



VARIETY TEST—Rows taken consecutively from label 8 to right are Irish Cobbler, Early Petoskey (Irish Cobbler Group) Green Mountain, Late Petoskey and Peerless Junior, (The latter two representing the Rural Group). Note difference in maturity between Irish Cobbler and Rural group as shown by greater top growth and earlier bloom, also note difference in habit of growth between the late maturing Green Mountain and Rural Groups.

regions. The variety Dala, grown in Scandinavia is over one hundred and fifty years old and is still vigorous and productive in spite of age. The so-called degeneracy of some of the older varieties is no doubt largely due to the introduction of better varieties. Peachblow, which has become extinct in most of the older regions is still commercially grown in a certain area of Colorado.

malties in tubers such as deep eyes, prominent eye yoke points, an elongated, cylindrical form, and tapering especially toward the proximal or stem end are frequently indicative of degeneracy.

Different soil types have a distinctive effect on potato tubers. Peculiarities of climate by affecting the habit of growth tend still further to modify the tubers of a region. These modifications, unless

they lower the economic value of a variety by resulting in a smaller yield or a change in type sufficient to cause them to have a lower market value, have usually been of only passing interest to the grower.

Not all varieties are equally modified by the same conditions. While one variety may lose its varietal type in a few years, another variety more adapted to the existing conditions will not be affected at all. The first case is frequently referred to as a "running out" or degenerating of that particular variety, even though its

productive power of his seed stock, this may be so gradual that it escapes notice, and unless the grower is observant of his plants in the field he is liable to consider the low yield due to seasonal conditions.

Many methods are practiced to overcome degeneracy. The Southern grower of potatoes secures each year new seed stock from the North. Even in Northern regions many growers find it beneficial to change their seed stock every few years. Securing seed from a different type of soil than their own has been found by



FIG. 2. Individual hill study in Early Ohio potatoes where degeneracy diseases are present. Note the uniformity of progeny from the same hill and the great variations between progeny of different hills.

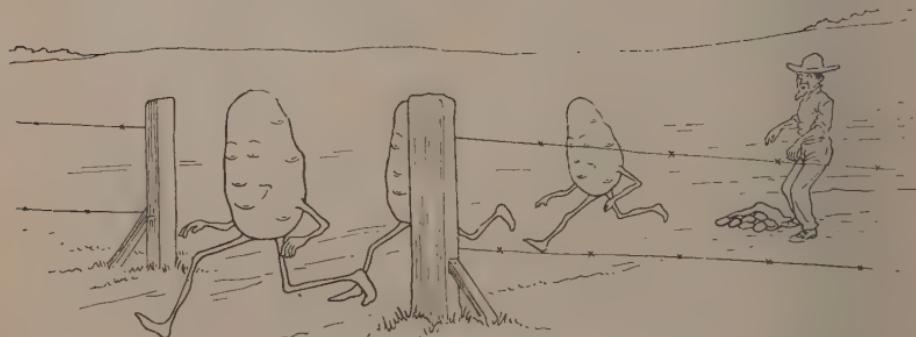
producing power may not have been lowered. Unusual seasonal conditions may cause abnormal tubers that revert to the original type the following season. Soil conditions may sometimes modify tuber characters to a considerable extent without impairing their vigor. The grower is generally able to detect the loss of type in his seed stock, especially where he is familiar with the ideal type of his variety. As to the falling away of the

growers to be beneficial. In most instances the necessity of securing new seed could be avoided by careful and continuous seed selection. Seed selection tends to improve the seed stock far above the average in productiveness while varietal mixtures are eliminated. A grower whose seed stock is below the average will usually find it more satisfactory to begin with new seed stock than to try to improve the old. In selecting new seed stock it is

essential to know the history of the lot, or its performance in previous years. It is not necessary as some growers believe, to obtain seed from another region; a neighbor's field may be of exactly the strain required. At the present time the state inspection and certification of seed enables the grower to secure reliable seed stock at a reasonable price. If a grower cannot keep up good seed stock by proper culture and careful selection, a change to another variety may be advisable.

The different response to soil and climate of varieties is well illustrated by the Green Mountain and Rural New-Yorker varieties. The Green Mountain gives the largest yield in regions having a cool, relatively moist climate and loose, friable soils, while in the drier, warmer regions with heavier soils the Rural New-Yorker is superior. The grower should secure the variety that is best adapted to his particular conditions. Where the so-called degeneracy diseases as leaf roll, mosaic and curly dwarf are present, the variety

may be kept up by securing new seed stock and thoroughly rogueing or weeding out the diseased plants in the seed plot. It cannot be too strongly emphasized that selection in this case is useless unless all weak and diseased plants are eliminated the moment they appear in the seed plot. Healthy plants when grown among these diseased plants retain their vigor and productiveness, but the progeny of these plants produce only weak and diseased hills. Where such diseases are present in the general field the seed plot should be isolated so that insects will not carry the infection into the seed stock. A grower can easily maintain the varietal type and vigor of his seed stock if he will familiarize himself with the variety grown, so as to be able to constantly select toward the ideal type and grow a seed plot where diseased and weak plants are carefully rogued out. It is needless to mention that proper care of the growing crop, such as tillage and spraying is of primary importance in order to keep seed stock from deteriorating.



DO NOT PLANT POTATOES THAT SHOW A TENDENCY TO RUN OUT.

HOW I MAKE AND USE POTATO SILAGE

H. G. LARSEN, MEADOWLANDS

A certain percentage of the potato crop is usually small, some scabby, and some damaged in digging; sometimes a surplus is on hand in the spring and summer and cannot be easily disposed of to any advantage. It may be of interest, especially to the small grower, the man on the small farm, in the timbered sections of the Northwest, that potatoes unfit for market may be turned into one of the very best feeds for cattle and hogs imaginable by the simple process of making silage out of them.

This is not a new invention nor my own recipe, although I have fed it to our own cows and hogs all summer; but it has been used in Denmark for many years and the prize bacon for which the English market was willing to pay fancy prices before the war, was made from this material chiefly. We, like many others, had a surplus of old potatoes last spring and no market, so I concluded to try the experiment and must say it exceeded my expectations by a long way. The outfit for making potato ensilage is simple and not expensive; six barrels, good big ones, vinegar or syrup barrels, a root cutter and a sack of cornmeal.

A day or two before making the silage the cornmeal was put into a tub and had water put in it enough to thoroughly saturate it but not make it sloppy. Let stand in a warm place to sour or ferment, it will soon begin to look and act like yeast or starter, and this is the function it has to perform in making potato ensilage. Potatoes alone will not ferment, but spoil; therefore from two to five per cent cornmeal must be used. Get your barrels and your starter (cornmeal) ready, scrub off the dirt from the potatoes (do not use rotten or decayed potatoes), run them through the root cutter, and put a bushel of the chopped potatoes into the bottom of the barrel, a little of the fermented cornmeal, some more potatoes, and pack down with a heavy piece of wood or any-

thing that will serve the purpose. Alternate potatoes and cornmeal till your barrel is full, and be sure it is well packed, the harder the better. Put some pieces of boards, cut to fit inside of top of barrel, and place a stone or two on top to weigh it down. Add no water nor salt—just the potatoes and cornmeal.

The potatoes furnish enough water and the fermented cornmeal acts as yeast; fermentation sets in, and after about three weeks (sooner if weather is warm) your feed is ready. By the way, your barrels should be covered with chaff or cut straw to exclude the air from the ensilage as the mixture settles in the barrel. This method makes it possible for the man with a few cows and a few pigs to have a real silo in his barn, a poor man's silo, if you please.

Do not draw the conclusion from the above that it will make a dry cow give milk, but here is what it has done for us. Our cows were dry this fall, except one, and she is due to freshen by the middle of January, yet she is supplying three families with all the milk they need. There are six youngsters in our own family, four in the next family, and six in the third. I am positive that if it were not for the potato silage she would have gone dry long before this. She is very fond of it and we expect to feed it to her all winter.

Keep your barrels covered when you begin feeding. Potato silage, like any other silage, will turn black and mold when exposed to the air. As soon as a barrel is empty, scrub it out and refill it, and you will find that the old cow will pay you a bigger price for your culs than you ever imagined. The potato market will pay you a premium for all the good first-class tubers you can raise, and you will want to raise twice as many potatoes as you did before. With carefully graded potatoes the market end will take care of itself. Culss are far too valuable to market when there is livestock to be fed.

Potato Silage

Made from Potatoes that are

UNFIT
for the
MARKET

A Meadowlands Farmer
Tells How

Read His Story

A LESSON IN POTATO IMPROVEMENT

Work of Clay County, Minnesota, Farm Bureau Described Before Annual Meeting of the Minnesota Potato Growers Association

F. E. BALMER, UNIVERSITY FARM

In Clay County was organized the first potato-improvement work conducted by a County Farm Bureau in Minnesota. This work was initiated by C. E. Brown of Elk River, who served that county as county agricultural agent during October, November and December, 1913. The project has been effectively continued by succeeding agents with the aid of extension specialists.

The first potato work undertaken dealt with demonstrations in seed selection and disease control, and these demonstrations were the first clear-cut types of organized demonstration work in farm bureau effort. The project has been taken up in other potato counties as Farm Bureau work was introduced, and its scope has been extended now to include not only seed selection and disease control, but also culture, standardization, certification, grading, storing, and marketing organization.

Every farm bureau in the state in the leading potato-producing counties has some feature of potato improvement included in its present year's program of work, and I believe I am correct in stating that the potato improvement project is the best organized activity of farm bureau work in the state.

I have been asked to give a summary of farm bureau activities in potato improvement, and in view of the extended activity on this project it is of course possible to give a summary only. It seems preferable to be as concrete as possible, limiting the presentation as to the nature and extent of results to one or two representative counties, as these will serve as examples for corresponding work in other counties.

This project has more history in Clay county than any other, and by using it

as one illustration we may review a greater range of results and witness the consistency toward improvement by the methods employed.

During the summer of 1914 seven farmers co-operated with County Agent P. E. Clement and the Minnesota College of Agriculture in demonstrations to show the effects of disease control. The demonstration plots comprised four or five acres in a potato field, and in every way received the same treatment as the field, except that the seed planted in the plots was treated in a solution of bichloride of mercury.

Four of the seven plots were so handled that it was possible to get definite comparisons as to results as shown by Table I.

Table No. 1. Results of Potato Seed Treatment, Clay County, Minnesota, 1914

Plot Number	Plot Yield	Field Yield	Difference	Type of Plot Potatoes	Disease Condition of Plots
1	350	200	160	good	Practically none
2	328	158	170	good	Practically none
3	135	105	30	good	Practically none
4	100	50	50	good	Practically none

In 1915 demonstrations were carried on in which the effects of disease elimination and seed selection were shown. For seed, potatoes of good type, blocky, with shallow eyes, were selected from the bins. About half an inch was clipped from the stem end to aid in eliminating any possible fusarium wilt. If any brown discoloration was found beyond this depth, the potato was discarded. After being clipped, they were dipped for an hour and a half in a solution of four

ounces of bichloride of mercury in 30 gallons of water.

The treated seed was planted in the regular field, the plot being a certain number of rows through the field, and comprising from two to six acres, having untreated rows on at least one side to be used as a check for comparison. Excepting the seed selection and the treatment for disease, they were handled the same as the field. The fields were located where potatoes had not been grown for

several years, to insure soil as free from disease as possible. In this particular the conditions of the field and the plot were identical.

Twenty of these plots were planted in the spring, but the June rains destroyed about half of them. In August the plots were inspected for disease, and infected vines were pulled and the tubers in those hills dug. The percentage of stand was also determined at this time. The results of this demonstration are tabulated in Table II.

Table II. Results of Potato Seed Selection and Disease Control, Clay County, Minnesota, 1915

Name	Yield per Acre, Bu.			Culls, Per Cent		Disease, Per Cent		Stand, Per Cent		Quality on Plot
	Plot	Field	Dif- ference	Plot	Field	Plot	Field	Plot	Field	
A. W. Berg.....	244	100	144	none	5	.1	2	100	88	More uniform, better type
L. Quame.....	256	121	135	.01	12	.5	4	100	92	More uniform, better type
T. Mellum.....	171	139	32	2	8	2.9	5.3	100	104	More uniform, better type
Van M. Storm.....	106	76	30	4	10	.2	4.6	100	90	More uniform, better type
A. J. Swenson.....	62	41	21	5	10	.8	.8	100	81	More uniform, better type
H. B. Plummer.....	137	112	25	2	8	.5	.8	100	100	More uniform, better type
Ben Moore.....	80	62	18	5	10	.5	2	100	94	More uniform, better type
John Erickson.....	74	50	24	5	8	2	8	100	84	More uniform, better type
J. H. Lewis.....	76	61	15	5	15	.5	.8	100	100	More uniform, better type
Frank Hunt.....	100	100	.....	.....	1	1.2	100	98	More uniform, better type	
Average.....	130	86	44.4	3.1	9.5	.9	3.6	100	93	More uniform, better type

The difference in the yields on the plots and fields in 1915 varied from nothing to 144 bushels per acre, with an average of 44.4 bushels. There was about 6 per cent more culls on the fields than on the plots. Taking the average yield as 100 bushels, there would be six bushels more of salable potatoes. This would bring the increased yield of salable potatoes to 50 bushels. The extra labor amounts to about four hours per acre, and the material costs about 25 cents.

While the diseases were not entirely eliminated, they were very much reduced. It will be noticed that there was very little difference in the percentage of disease and also in the stand between the plots and fields of Mr. Plummer, Mr.

Lewis and Mr. Hunt. These three treated the seed for the field as well as for the plot, the only difference being that the stem end was not clipped to eliminate the fusarium wilt from the seed for the field. This shows that the diseases cause a decrease of about 10 per cent in the stand. This alone will lessen the yield from 10 to 20 bushels per acre.

The high percentage of disease found in Theo. Mellum's plot is probably due to the fact that potatoes were grown on this land two years before. As most of these diseases will live over in the soil for four or five years, it is advisable not to plant potatoes on the same land oftener than once in five years.

For the sake of comparison the stand on the plot was assumed to be 100 per cent. For example, in the first plot the stand on the field was 88 per cent of the stand on the plot. The poor yield on both the plot and field of Mr. Swenson was due to the heavy rain in June.

Other Increase Yields

In addition to the supervised demonstrations reported in Table II, a number of potato growers were interested in the project and made application of the treating method on their farms. These men reported results as follows:

H. P. Hendrickson: Secured 183 bushels per acre where seed was selected and

treated, against a yield of 75 bushels with bin-run seed.

O. J. Grover: Secured a 35 per cent increase from seed grown in his seed plot in 1914, against the remainder of the field, with better quality and more uniformity.

Theo. Skrei: Secured 200 bushels with seed from the 1914 seed plot, against 150 bushels from bin-run.

B. H. Briggs: Reported a double yield by the same method.

Several others secured similar results.

The results of 1916 were just as striking and persistent, as is shown by Table III.

Table III. Continuation of Potato Demonstrations in Clay County, Minnesota, 1916

Plot Number	Yield		Difference Bushels	Disease		Stand	
	Plot Bushels	Field Bushels		Plot Per Cent	Field Per Cent	Plot Per Cent	Field Per Cent
1.....	203.80	162.73*	41.07	Trace	0.5	100	95
2.....	142.47	131.24	11.23	.....	.....	.....	.....
3.....	212.42	152.31*	60.11	Trace	1.0	.....	.....
4.....	143.92	158.11*	14.19	0.1	1.3	100	75
5.....	160.0	110.0	50.0	.....	.....	.....	.....
6.....	198.33	176.51	21.82	0.5	2.0	100	91
7.....	269.5	207.9	6.16	None	3.1	.....	.....
8.....	203.46	185.62	17.84	.....	.....	.....	.....
9.....	64.4	54.7	9.7	0.1	1.0	100	90
10.....	166.72	136.62	30.10	.....	.....	.....	.....
11.....	217.6	190.2*	27.4	0.8	2.0	.....	.....
12.....	263.5	184.8*	78.7	0.3	1.0	100	97

*—Treated.

The project was continued similarly in 1917, though more attention was devoted by the county agent and the Farm Bureau to inducing the potato growers generally throughout the county to select and treat the potatoes. About 1,000 growers treated that year, as compared to 500 during 1916.

A number of supervised demonstrations were continued, however, in order to have local proof that the practice should be continued. Ten men co-operated as demonstrators. The extremely dry season resulted in a very poor crop for the demonstrators. Unfortunately, some of the plots were frozen. Results on six plots where accurate data could be obtained are shown in the following table:

Table IV. Results of Seed Selection and Disease Control, Clay County, Minn., 1917

Co-operators	Plot Yield	Field Yield	Differ- ence
Dan O'Donnell.....	109	72	37
T. H. Skrei.....	120	80	40
A. O. Solwold.....	120	90	30
H. B. Plummer.....	75	54	21
Arthur Lewis.....	70	65	5
Jacob Hurrier.....	110	102	8

Several of the above men have been selecting and treating their seed for several years; hence the differences in yield are not as large as in earlier years, when the check fields were planted from bin-run seed.

It is pertinent to mention in connection with the work for 1917 that potatoes were inspected by A. G. Tolaas, specialist in plant pathology with the Agricultural Extension Division, for 16 farmers of the county, that certificates might be issued as to the freedom from disease. This was no doubt the initial operation leading to the present system of seed potato certification.

The fifth year's results, obtained in 1918, demonstrate the effectiveness of the practice of seed selection and treating similar to what was obtained during the previous years. The methods employed were practically the same as used before. The fields preferably were located where potatoes had not been grown for several years, but in this respect the soils of plot and field were identical. In July and August the plots were inspected for disease, and affected vines were pulled and tubers from such hills were dug. The percentage of stand was also determined at that time. In 1918 nine co-operators participated in the demonstrations and the results are charted in Table V.

Table V. Results of Seed Potato Selection and Disease Control Demonstrations, Clay County, 1918

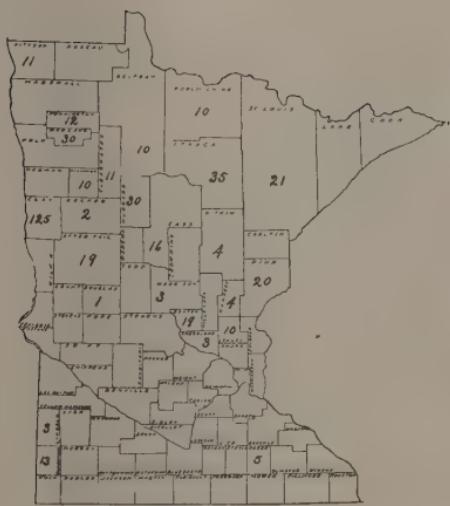
Name	Yield per Acre			Culls,		Disease,		Stand,		Quality on Plot
	Plot	Field	Dif- ference	Plot	Field	Plot	Field	Plot	Field	
U. Legler.....	100	75	25	2	5	.2	9.0	100	88	More uniform, better type
John Seter.....	165.4	75	90.4	3	8	1	2.5	100	96	More uniform, better type
Wm. Sprung.....	141	135	6	1	4	.7	4	100	98	More uniform, better type
Theo. Skrei.....	175	115	60	2	7	2	2.3	100	90	More uniform, better type
T. Campbell.....	115	90	25	1	9	23	10	100	81	More uniform, better type
J. J. Johnson.....	134.8	105	29.8	2	5	3	3.5	100	97	More uniform, better type
O. Syverson.....	110.5	70	40.5	3	10	3	10.3	100	92	More uniform, better type
Ed Greening.....	277.6	90	187.6	2	8	0	8	100	94	More uniform, better type
John Singer.....	114.8	90	24.8	2	5	1	2	100	98	More uniform, better type
Average.....	147.1	93.9	53.2	2.2	6.8	.86	5.7	100	92.6	More uniform, better type

Differences in yield in 1918 varied from 6 bushels to 187.6 with an average of 53.2 bushels. There was about 4 per cent more culls in the field than on the plots. Figuring an average yield of 100 bushels per acre, this would mean 4 bushels more of salable potatoes, which would also mean an increased yield of salable potatoes amounting to 57 bushels, as against 53.1 bushels as reported in Table V.

After having so effectively demonstrated the value of selection and treatment, the Clay county farm bureau decided to direct more attention to seed certifi-

cation. As has already been stated the potatoes of 16 growers were inspected in the fall of 1917. Only the potatoes of men who had been selecting and treating their seed for several years were so inspected. If their potatoes were of desirable type and had a low percentage of disease, a certificate was issued. Eleven of the 16 growers received letters of recommendation as to superior stock in the fall of 1917.

By advertising the names of these growers in the seed-buying states of Kansas, Nebraska, Missouri and other



Seed Potato Plots in Minnesota in 1918
Twenty five Counties with 427 Plots



Seed Potato Plots in Minnesota in 1919
Thirty nine Counties with 1581 Plots

states these men were enabled through the Farm Bureau to sell their stock at from 30 to 50 cents per hundred above the price locally. In all, 20,000 bushels were sold in this way. In the spring of 1918, twenty-five growers asked that their stock be inspected for certification. The very distinctive organization known as the Clay County Co-operative Certified Seed Potato Growers' Association is an out-growth of these several years' work on potato improvement.

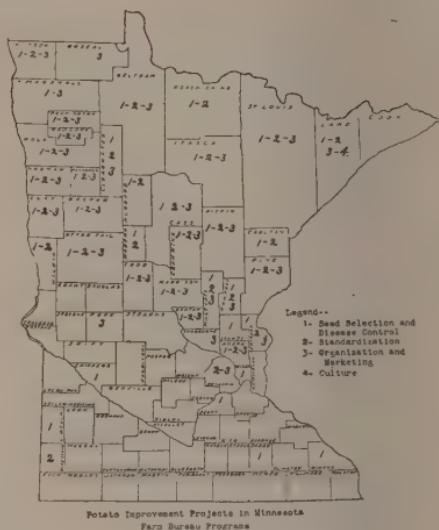
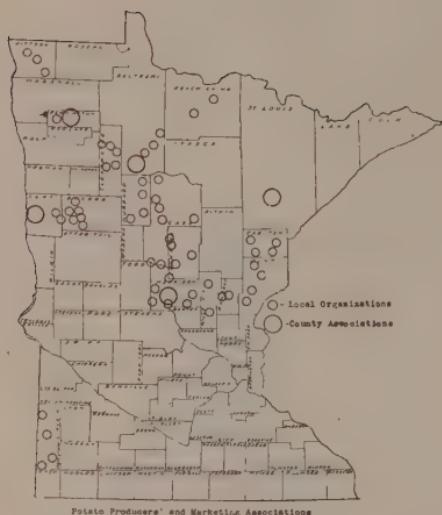
It would be possible to extend indefinitely an outline of the achievements of other counties with the same project, but they would very largely be a repetition, and the obtaining of results so true to form for a period of years proves the effectiveness of the demonstration and the methods employed.

It seems meet to endeavor to answer what are some of the factors of the success of the potato demonstration work in Clay county. To begin with, this county has been forging ahead for a period of about 35 years as a center of production of a standard product—the Early Ohio potatoes. Then the potato growers and dealers of the county didn't put their light under a bushel, but let the country

know about the standard and superior product they were producing.

When the farm bureau was organized in the county in 1913, the leaders had in mind that there was at least one definite job they were going to keep at persistently until abundant results were achieved. That they had potato improvement in mind is evidenced by the fact that the first county agent employed to manage the bureau work was a successful potato grower, and it has been made known to succeeding agents that potato improvement was to be made a persistent, yes, a perennial, project.

Now for a brief summarization of activities at large throughout the state. It has already been stated that the first seed-selection and disease-control plot work done by a Farm Bureau was that in Clay county in 1914, seven potato growers co-operating in the demonstration. In some of the other potato counties establishing Farm Bureau work early, particularly Ottertail, Crow Wing, Koochiching, and St. Louis, similar work was undertaken as in Clay county. The Farm Bureau work was not generally introduced until 1918, and in some counties rather late in that year, so far as it was possible to organize potato demonstration work.



However, in 1918, twenty counties were able to organize the seed potato work, having 373 plots. The number of counties in 1919 grew to 30, with 1,287 plots, totaling 1,314 acres. The growing practice of seed treatment is made quite evident, further, in that county agents reported in 1918 that 642 pounds of corrosive sublimate were used, whereas in 1919 the amount grew to 2,735 pounds. Also 1,162 pounds of formalin were used in 1918, and 1,642 pounds in 1919.

Results in 1919

The year 1919 is the sixth consecutive year in which the potato improvement project has been made a primary activity of the Farm Bureau work in Clay County. It is estimated by the County Agent that at least 900 farmers in the county treat-

ed their seed potatoes and planted not less than 8,000 acres with treated seed in the spring of 1919. Approximately 1,000 pounds of corrosive sublimate were used this year for seed treatment as compared with 400 pounds in 1918. Forty-four farmers asked to have their seed certified. A total of 600 acres were inspected for seed certification and about one-half of the growers received certificates. A few supervised demonstration plots were conducted this year, the same as for the previous years, in order to have a further accumulation of evidence as to the value and importance of applying the methods used in the seed selection and disease control demonstration work. The following table outlines the demonstration results for 1919:

Table VI. Results Seed Potato Selection and Disease Control Demonstrations, Clay County, 1919

	Yield per Acre		Difference in Yield per Acre	Disease	
	Plot	Field		Plot	Field
U. Legler.....	125	115	10	1.75	4.75
Wm. Sprung.....	110	75	35	1.25	2.75
Theo. Skrei.....	195	175	20	1.50	2.10
O. Syvertson.....	125	100	25	2.20	6.50
T. N. Wiger.....	125	110	15	1.00	3.30
E. J. Corwin.....	135	105	30	0.00	0.50
J. F. Prenosill.....	70	142	28	2.00	5.50
Average.....	140.7	117.4	23.2	1.38	3.62

As noted in the table there is an average increase of 23.2 bushels per acre secured as a result of seed selection and treatment of seed, a result which corresponds to that obtained during each of the preceding five years.⁷ The value of selecting and treating seed to rid the county of potato diseases has been thoroughly demonstrated, in Clay county. Every year the number of growers who select and treat their seed is growing. The increase in the amount of corrosive sublimate used in treating seed is conclusive evidence that the potatoes are selected and treated for increased acreages

each succeeding year. The fact that certified disease free seed has been sold during the fall of 1919 at a premium of about 25 cents per bushel over common stock indicates a big return on the cost and labor of seed selection and seed treatment.

The value of the potato-growing industry in Clay county looks very hopeful because the farm bureau and the growers in their persistent efforts have developed a superior seed product which it will be profitable for potato growers in other sections to obtain even at prices considerably above premium.

HOW MUCH DOES IT COST TO CLEAR POPLAR LAND WITH TRACTORS?

W. L. CAVERT, UNIVERSITY FARM

During the past several years a number of farmers have found that poplar land can be rapidly cleared by the use of tractors and giant breaker plows. Due to the general interest in this subject in the eastern part of Kittson County, it was thought that figures showing experiences as to the cost of clearing poplar land with tractors would be appreciated by a number of farmers. Accordingly, complete figures or estimates as to the cost of clearing land were secured from eight tractor owners who have done extensive breaking of poplar land with tractors.

One of these co-operators, J. E. Shanks, Lancaster, has broken over 300 acres of poplar land during the last three years on his own land besides doing considerable work for his neighbors.

Engine Cost

The eight co-operators used their tractors during the year as follows:

Belt work, mostly threshing	.28 days
Plowing	.....12 days
Brush breaking	.....25 days

Total per season.....65 days

These tractor owners estimated the average life of their tractors to be eight

years. Upon this basis the average overhead cost of the eight tractors per year would be as follows:

Depreciation	.....\$408
Interest at 8% on $\frac{1}{4}$ of first cost.	127
Repairs including owners time	115
Taxes at $\frac{1}{4}$ of 1%	8

Total	.....\$658
Overhead expense per day of use	\$10.12.

These engines vary in size from the small tractor pulling one breaker to the 30-60 engine pulling three breakers.

There was much difference of opinion among the owners of these outfits as to the extent brush breaking was harder on the tractor than ordinary plowing. If one assumes that one day of brush breaking would wear engine as much as two days of other work the overhead expense of the engine per day for breaking would be \$14.60. This latter figure has been used in the following data:

Plow Cost

The overhead expense for breaker plows was estimated to be the following:

Depreciation at 10% of first cost\$36
Interest at 8% on $\frac{1}{2}$ of first cost	14
Sharpening and repairs20

Taxes.....	1
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Total per season.....	\$71
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Upon the average the breaker plows were used 25 days per season making the cost per day \$2.84. The life of the plow was arbitrarily estimated to be 10 years.

Operating Cost

The average daily operating cost of the eight outfits was estimated to be the following:

Fuel 38 $\frac{1}{2}$ gals. gas or kerosene..	\$8.50
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Oil and grease.....	2.50
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Engineer.....	5.50
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Ploughmen.....	6.38
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Total.....	\$22.88
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Three of the engines used gasoline and 5 used kerosene. Of the eight outfits, 4 were using one giant breaker bottom, 3 were using two giant breaker bottoms, and 1 was using three giant breaker bottoms.

Summary of Cost

Engine cost per day.....	\$14.60
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Plow cost per day.....	2.84
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Fuel and oil per day.....	9.74
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Labor.....	11.88
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Total daily cost*.....	\$39.06
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Acres per day 5.3.	
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Cost per acre \$7.37.	
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If one assumes that a day of brush breaking did not depreciate the engine more than one day of other average use the cost would be \$6.52 per acre. The cost will vary according to the conditions and also according to the days per year that the tractor and breaker plows can be used. If one has only a small amount of breaking, it would doubtless be much

more economical to hire a custom outfit at the current rate of \$8 to \$10 per acre. These operators found that they could plow under all the brush that a tractor could break down. Stumps up to seven or eight inches are plowed under while any large stumps must be grubbed or dynamited.

Cropping the Land

The plan recommended by farmers who have broken poplar land is to put in flax as a first crop and following the flax a small grain crop is stubbled in. At the end of two years the poplar brush is sufficiently rotted so that there is no trouble in back setting it. Several fields of flax and buckwheat were observed upon land that had a big growth of poplar a year ago.

Getting Ready to Break

Where there is such a heavy growth of poplar that it cannot be broken down the growth is cut off level with the ground, the brush burned, and any large stumps grubbed or dynamited. Several operators stated that on light brush that did not furnish any firewood, it was very helpful if the land to be cleared was burned over during the year previous to clearing. The cost of cutting and burning brush upon the jobs visited varied from nothing to \$8.00 per acre.

The favorite plow seems to be the giant 24-inch breaker, costing \$300 to \$325. Several were using 20-inch plows and reported them satisfactory.

There is every indication with the large scale clearing made possible by the use of tractors, that rapid progress will be made in putting under cultivation such poplar land as is free from stones and well adapted to farming.



TURNING UNDER POPLAR BRUSH WITH A 30-60 TRACTOR AND THREE 20-INCH BREAKER BOTTOMS.
FARM OF O. S. HOMSTAD, LANCASTER, MINN.



A FIELD OF BUCKWHEAT IN LATE JULY WHERE POPLAR BRUSH WAS GROWING IN APRIL.
FARM OF J. E. SHANKS, LANCASTER, MINN.

THE EFFECT OF CERTAIN PLANTING PRACTICES ON THE YIELD OF POTATOES

FRED A. KRANTZ, UNIVERSITY FARM

The potato-growing regions of Minnesota include such a wide range of soils and climate that the planting practices, being adapted to local conditions, differ widely in the various parts of the state. In localities of similar soil and climate, however, there is not an entire agreement among growers as to the amount of seed required per acre, the proper distance between hills, or the best time to plant potatoes.

piece. As the size of the seed piece is increased the average number of tubers produced per hill becomes greater, and the size of the tubers smaller. On the other hand a seed piece that does not contain sufficient plant food to produce a strong healthy plant will result in few tubers being set and frequently the plant is too weak to develop these to a marketable size.

Between these two extremes we must



FIG. 1. Effect of planting different sized cut seed pieces. Rows to right of stake 9 are 1 ounce, 2 ounce and 3 ounce cut pieces respectively. Note the greater density of foliage as weight of seed piece is increased.

For a number of years investigations were made at University Farm, of the relative merits of the various planting practices. These results showed that the size of the seed piece is more important than the number of eyes, one or two good eyes on a seed piece being sufficient, and that the yield is increased within certain limits with the increase in size of seed

seek the size of seed piece that will insure a healthy, vigorous hill, capable of producing the greatest number of marketable tubers. In the Early Ohio variety, grown on heavy clay soil, one ounce seed pieces grown fifteen inches apart in a row, with rows three feet apart, were found to be the most profitable. The price of the seed stock is an important consideration.

When potatoes are cheap a greater amount can be planted per acre with profit to the grower than when potatoes in the spring of the year are high in price.

As a general rule it may be stated that the seed piece in the Early Ohio variety under conditions existing in this state should not be less than three-fourths of an ounce, and rarely would it be advisable to plant seed greater than one and one-half ounces in size. The greater the fer-

ounce size is preferable. It can be profitably increased to two ounces whenever seed potatoes are cheap enough so that there is a fair prospect of getting more money from three bushels of the crop than one bushel of the seed is worth. To sum up briefly it can be said that the maximum size of seed piece that can be profitably used is directly dependent on fertility and condition of soil together with the price of seed.



FIG. 2. Effect of planting different sized whole tubers.

Row at stake is check row—1 oz. cut pieces, to right are rows planted to 2 oz., 3 oz. and 4 oz. whole tubers respectively. As in previous figure note increased density of foliage with increase in size of tuber planted.

tility and the heavier the type of soil the closer will be the planting distance; in less fertile and more sandy soils the planting distances will be greater.

The late maturing varieties, Rural New-Yorker and Green Mountain, were also studied. The size of seed piece that could satisfactorily be planted was found to lie between one ounce and two ounces. In most instances a one and one-half

In order to give the grower an idea of the quantity of seed potatoes required per acre for pieces of different size, the following table is given. As the grower usually knows approximately the number of bushels he is planting per acre and how far apart he is planting; he can tell from this table how large he should cut the pieces.

Size of Seed Pieces	Rows 3 feet apart		Rows 3½ feet apart	
	Hills 15 in. apart	Hills 18 in. apart	Hills 14 in. apart	Hills 17 in. apart
¾ oz.	9 bu.	7.5 bu.	8.3 bu.	6.8 bu.
1 oz.	12 bu.	10. bu.	11. bu.	9. bu.
1¼ oz.	15 bu.	12.5 bu.	14. bu.	11.3 bu.
1½ oz.	18 bu.	15. bu.	16.5 bu.	13.7 bu.

The question often arises as to the relative value of different portions of the potato tuber for seed purposes. The seed pieces from the distal or seed end of tubers will when planted sprout quicker and will appear above ground earlier and more uniformly than the seed pieces from the proximal or stem end of the tubers. Also the seed pieces of the seed end will average a greater number of stalks per hill and consequently a greater number of tubers per hill of a smaller average size. The variation in yield of marketable tubers is too slight to make it advisable for any distinction to be made between the different portions of the tuber for seed.

Another important factor in the yield of potatoes, to which the grower fre-

quently does not give the proper consideration is the time of planting. There is a tendency for growers to delay planting in the spring later than necessary, especially of the late maturing varieties which in certain sections of the state require the entire growing season to mature. It is often advisable for the growers to plant the late maturing varieties which have a longer growing period, before the earlier maturing varieties, except in those localities where the early varieties are grown for the early market trade. At the University Farm the earlier plantings have, with few exceptions, given higher yields; a difference of two weeks in planting in 1917 resulted in a difference of one hundred bushels per acre in favor of the earlier planting. The long growing season of a few abnormal years resulted in the late plantings producing the higher yields. In normal seasons the early portion of the growing season is the most favorable to the growth of the crop. Further, the last month of the plants' growth is utilized in the formation of tubers, and the shortening of this period by frost results in a severe check on the yield.

**REPORT ON INVESTIGATIONS
WITH POTATOES AT THE
NORTH CENTRAL EXPERIMENT STATION,
GRAND RAPIDS, MINNESOTA**
OTTO I. BERGH, SUPERINTENDENT

The climate and the soil of north central Minnesota are both favorable for potatoes. The potato crop is the main crop grown for market on most farms in the territory. Grown on land newly cleared, or on land previously in clover, the yields are large and the quality unexcelled, so that, on most farms the potato crop is given a place among the major field crops in the rotation.

The North Central Experiment Station has therefore given due attention to investigational work with potatoes. This work may be summarized under the following headings: 1st. Variety Testing; 2nd. Potato Improvement; 3rd. Fertilizer Treatments; 4th. Cultural Methods; and 5th. Field Practice.

Variety Test

The variety testing has been carried on at this Station for the past twenty years, and has included a large number of varieties. The results from these tests have been reported from time to time in Station bulletins. The most promising varieties, however, include those adopted in 1916 by the Minnesota Potato Growers Association as the standard varieties for Minnesota. Since then the work has been limited to these eight standard varieties and one other, the "Itasca," a Green Mountain seedling propagated from seed gathered at this Station by Mr. Geo. F. Kremer of Grand Rapids. The results are summarized in table No. 1.

TABLE NO. 1
POTATO VARIETIES
(Bushels per Acre)

Variety	1917	1918	1919	Three Years Average	Per cent U. S. Grade No. 1*	Bushels Per Acre U. S. Grade No. 1*
Green Mountains.....	373.58	374.7	414.2	354.16	92.9%	329.02
Burbanks.....	254.63	415.3	307.5	325.81	74.2%	241.75
Kings.....	275.58	318.7	340.1	311.46	94.1%	293.08
Irish Cobblers.....	300.83	318.3	398.0	305.71	89.7%	274.22
Burbank Russets.....	270.17	354.7	289.7	304.86	77.6%	236.57
Rural New Yorkers.....	211.83	318.0	342.8	290.87	91.8%	267.22
Bliss Triumphs.....	258.67	254.36	257.1	256.71	91.6%	235.15
Early Ohios.....	299.66	250.0	209.0	252.88	87.7%	221.78
"Itasca" Green Mountain Seedling.....	.....	381.3	376.2	378.75	89.6%	329.36

Note (*) Graded over Bogg Grader one and seven-eighths inch mesh revolving screen.

All varieties under test, except the Green Mountain and the Green Mountain seedlings, were purchased from growers in the State in 1916 and 1917 and were from the very best stock obtainable. The Green Mountains used are from stock grown at this Station for many years and

throughout the testing work have ranked as one of the largest yielders and a most satisfactory all round late variety. The Green Mountain seedling, called the "Itasca," is quite similar to its parent in color of blossom, leaves and tubers. The vines, however, are less spreading. The

tubers set closer together in the hill and seem to be slightly earlier. The tubers are smoother than the true Green Mountains and are more rounded on the ends. There are fewer over-grown rough tubers. The eyes are somewhat shallower. The flesh is uniform and firm. Cooking quality excellent and the flavor pleasing.

Potato Improvement

The potato improvement work carried on at this Station has for its main object the development of superior seed strains and their distribution to the potato growers in this State and other States. This work is being done in co-operation with Dr. Wm. Stuart, Chief of Potato Investigations in the United States Bureau of Plant Industry. The procedure is in brief as follows: 100 pound lots of seed is obtained from growers in the State whose fields have previously been inspected and found vigorous of growth, producing tubers of good quality, true to variety, of good type, and free from disease. These are carefully sorted, treated for disease and planted in plots on a field selected for its uniformity of soil and other factors. The plots are care-

fully gone over several times during the growing season by expert field men of the U. S. Department of Agriculture, notes are taken on each plot with reference to vigor of plants, purity as to variety and the prevalence of disease. All diseased plants are removed. At harvest the crop is again checked over by one of the Government field men. The yield from each plot is carefully ascertained and the quality and condition of the tubers observed and recorded. The crop from the best plot of each variety is then reserved to be planted on an increase-plot the next year to produce seed for distribution. New lots are received and tested each year and compared with the best lot of the previous year. The varieties included in this seed development work are the Green Mountain, Rural New Yorker, Early Ohio, Triumph and Cobbler.

Fertilizer Treatments

Fertilizer treatments for potatoes have been carried on both on upland mineral soil and on peat land. The fertilizer projects on upland have been carried on for five years and include the comparison of manure vs. no manure; Acid Phosphate

TABLE NO. 2
Rock Phosphate vs. Check
1000 lbs. per acre, 1914

Treatment.....	1915	1916	1917	1918	1919	5 years' Average
Rock Phosphate.....	131.6	95.6	155.3	170.5	179.9	146.58
Check.....	124.3	106.3	157.7	136.3	126.0	130.12
Increase.....	7.3	-10.7	-2.4	34.2	53.9	16.46

TABLE No. 3
Acid Phosphate vs. Check
360 lbs. per Acre once in rotation (3 years)

Treatment	1915	1916	1917	1918	1919	5 Years' Average
Acid Phosphate.....	141.0	104.6	179.5	154.2	154.2	146.70
Check.....	124.3	106.3	157.7	136.3	126.0	130.12
Increase.....	16.7	-1.7	21.8	17.9	28.2	16.58

vs. Rock Phosphate with and without stable manure, and the application of raw peat in varying quantities from ten to forty tons per acre, to compare with applications of stable manure from five to

twenty tons per acre once in three years in a rotation of oats, clover and timothy meadow, and potatoes. These projects include 93 one-tenth acre plots. The results are given in the tables below.

TABLE NO. 4

Rock Phosphate and Manure vs. Manure Only

1000 lbs. per Acre, 1914. 10 tons per Acre once in rotation (3 Years)

Treatment	1915	1916	1917	1918	1919	5 Years' Average
R. Phos. and Manure.....	179.6	145.8	260.5	285.9	285.2	231.40
Manure Only.....	180.9	169.7	253.6	257.4	292.6	230.84
Increase.....	1.3	23.9	6.9	28.5	7.4	.56

TABLE NO. 5

Acid Phosphate and Manure vs. Manure Only

(360 lbs.) (10 tons) (10 tons)

Treatment	1915	1916	1917	1918	1919	5 Years' Average
A. Phosphate and Manure.....	183.3	163.6	266.2	272.6	321.2	241.38
Manure Only.....	180.9	169.7	253.6	257.4	292.6	230.84
Increase.....	2.4	6.1	12.6	15.2	28.6	10.54

TABLE NO. 6

All Manured Plots (9) vs. All No Manure Plots (9)

Treatment	1915	1916	1917	1918	1919	5 Years' Average
Manured.....	181.2	159.7	260.1	271.9	299.7	234.52
No Manure.....	132.3	102.1	164.1	153.6	153.3	141.08
Increase.....	48.9	57.6	96.0	118.3	146.4	93.44

TABLE NO. 7

Average for All Treatments

Treatment	1915	1916	1917	1918	1919	5 Years' Average
Check.....	124.3	106.3	157.7	136.3	126.0	130.12
Rock Phosphate.....	131.6	95.6	155.3	170.5	179.9	146.58
M. Rock Phosphate.....	179.6	145.8	260.5	285.9	285.2	231.40
Manure.....	180.9	169.7	253.6	257.4	259.3	230.84
M. Acid Phosphate.....	183.3	163.6	266.2	272.6	321.2	241.38
Acid Phosphate.....	141.0	104.6	179.5	154.2	154.2	146.70

The yields given in the above tables are in each case the average from three plots. The Rock Phosphate was applied at the rate of 1000 pounds per acre in 1914. Stable manure at the rate of 10 tons to the acre is applied once in the rotation (3 years) on the clover sod preceding potatoes. Acid Phosphate is applied at the rate of 360 pounds per acre in the rotation (3 years) on the potato land just before planting.

It will be noted that the only treatment showing a decided beneficial effect is that from 10 tons stable manure. The attention of the reader should be called to the fact that the years 1915, 1916 and 1917 comprised the first rotation. The years 1918, 1919 and 1920 will comprise the

second rotation. The plots receiving manure will then have received twenty tons each. The yield as indicated by the tables shows a market increase from this second application. The yields of the plots receiving manure (Table 6) though otherwise being treated the same as the plots with no manure show an increase in favor of manure at the rate of 118.3 bushels per acre in 1918 and 147.4 bushels per acre in 1919. In other words, with potatoes selling at \$1.00 per bushel the manure application gave a return in 1919 in increased yield of potatoes of \$14.74 for each ton of manure applied. This may be termed the indirect profit from live stock. Table No. 8 also shows the effect of stable manure on the other crops in the rotation.

TABLE 8
Average Yields
1915 to 1919
Upland Fertilizer Project

Crops	Treatment	1915	1916	1917	1918	1919	5 Years' Average
OATS	Manure.....	53.3 bu.	40.8 bu.	39.2 bu.	38.3 bu.	46.6 bu.	43.4 bu.
	No Manure...	44.4 bu.	32.8 bu.	35.9 bu.	28.8 bu.	38.1 bu.	36.0 bu.
	Increase.....	8.9 bu.	8.0 bu.	3.3 bu.	9.5 bu.	8.5 bu.	7.4 bu.
CLOVER AND TIMOTHY HAY	Manure.....		3533 lbs.	1971 lbs.	2058 lbs.	5232 lbs.	3198 lbs.
	No Manure...		3094 lbs.	1756 lbs.	1410 lbs.	3480 lbs.	2435 lbs... .
	Increase.....		439 lbs.	215 lbs.	648 lbs.	1752 lbs.	763 lbs.
POTATOES	Manure.....	181.2 bu.	159.7 bu.	260.1 bu.	271.9 bu.	299.7 bu.	234.5 bu.
	No Manure...	132.3 bu.	102.2 bu.	164.1 bu.	153.6 bu.	153.3 bu.	141.1 bu.
	Increase.....	48.9 bu.	57.5 bu.	96.0 bu.	118.3 bu.	146.4 bu.	93.4 bu.

Table No. 9 shows the results from the application on upland soil of raw wet peat in varying quantities of from ten to forty tons per acre compared with applications of stable manure at the rate of five to twenty tons per acre. In this project,

also, the beneficial effects from stable manure are marked. While the effect from the application of peat is not great it indicates that the application is beneficial to potatoes and compares with stable manure in the ratio of about eight to one. It

TABLE NO. 9
Peat vs. Manure
(Potatoes)
East Half

Treatment	1915	1916	1917	1918	1919	5 Years' Average
Check.....	147.3	108.6	138.3	142.0	165.1	140.26
5 Ton Manure.....	175.6	75.6	213.3	212.0	222.3	179.76
20 Ton Manure.....	184.2	130.6	302.5	279.5	341.1	247.58
10 Ton Peat*.....	125.0	117.3	152.5	157.9	173.4	145.26
20 Ton Peat*.....	116.3	110.5	176.2	177.9	205.3	157.24
40 Ton Peat*.....	116.3	137.5	176.6	205.8	253.3	177.90

*Spreader loads, approximately one ton of wet raw peat.

may be, however, that the peat decomposing less rapidly than the manure, has not yet had an opportunity to indicate its fertilizer value. However, this interesting question can only be solved by continuing the project. It should be noted also that the field occupied by these plots had been cropped to a three year rotation since 1895 and had received applications of stable manure previous to 1914, the residual effect of which will have an influence on the yield of the check plots, but that this effect will be less as the project continues.

The work with potatoes on peat land has consisted of variety testing and fertilizer treatments. However, due to summer frosts the results obtained have been indefinite. Fair yields have been obtained in years when summer frosts did not interfere. However, our experience will warrant warning farmers not to risk much in potatoes on peat land in this district.

Cultural Methods

Trials were begun in 1915 to compare (a) mature vs. immature potatoes for seed. (b) Size of seed; (c) rate of planting; (d) time of planting and (e) comparing seed from crop produced on upland mineral soil with seed produced on peat land. This work was discontinued during the war on account of scarcity of labor. The data so far obtained are hardly sufficient to base recommendations on. The results

so far obtained, however, can in brief be summarized as follows:

(a) The immature seed gave fully as large yields as the mature seed.

(b) The results from seed of different sizes, that is, potatoes planted whole, half, quarters, and ordinary cut (being a mixture of halves quarters, and wholes) depending on the size of the tubers, indicate that the yields increased directly with the size of the seed pieces. The whole potatoes giving the largest yield, the halves second, ordinary cut third, and the quarters giving the lowest yield. The per cent of marketable potatoes from the planting of different size seed pieces, however, resulted in 88.4 per cent for the quarter seed; 88.0 per cent for the seed cut in halves; 86.9 per cent from the whole tubers and 86.7 per cent for the ordinary cut. Which indicates that there was a larger per cent of small tubers produced where the large seed pieces were used.

(c & d). Results from rate of planting and time of planting have so far been rather conflicting and would indicate that the field condition and the seasonal weather conditions are to a large extent determining factors. A fertile field receiving plenty of rain would stand closer planting than would a field deficient in fertility and lacking in moisture. The plots planted at different dates may give varying effects from the same cause, such as drought or rains; the degree of injury

or benefit being determined by the stage of growth the plant is in when so influenced.

(e) The crop from seed grown on peat land gave fully as good returns as the crop from seed produced on upland mineral soil, though the seed tubers from the peat soil were small and immature as compared with the seed produced on upland.

Field Practice

The practice at this Station is to have clover precede potatoes in the rotation. The soil on most of the Station fields is a sandy loam. If the meadow is infected with quack grass it is plowed shallow after the hay crop has been harvested and left fallow without further tillage until late fall when it is thoroughly disked and left open for the winter. Stable manure is applied during the winter and early spring and is incorporated with the soil either by disking or harrowing with a spring tooth harrow. Just before planting, the field is again plowed six to eight inches deep and harrowed into condition for planting.

On fields free from quack grass our practice on light sandy soil is as follows: Manure is applied on the clover meadow usually in the spring preceding the hay crop. The clover stubble is thoroughly disked, this is done either in the fall or in the spring. The field is plowed six to eight inches deep usually in the spring just before planting and harrowed into condition. With heavy soil, fall plowing is recommended.

The field is given a blind cultivation after planting, and as the sprouts begin to appear in the row the field is harrowed lightly, cross-wise, followed later by cultivation as needed. Level cultivation is practiced where the soil is loose and open, which it usually is here in years of normal rainfall.

During wet years hilling is recommended, and especially if the soil is firm and set causing the tubers to appear above the surface. Hilling is almost always advisable on heavy soil.

The seed used is the very best obtainable. This is sorted over and all diseased

tubers discarded, as well as tubers not true to variety and type. The seed is then treated, a bushel to the sack, by immersion one and a half hours in a corrosive sublimate solution made up of four ounces of corrosive sublimate (bichloride of mercury, $HgCl_2$) in thirty gallons of water. Four ounces of corrosive sublimate is dissolved by being put into the empty barrel and a pail of hot water poured over it. Cold water is then added up to thirty gallons.

After treating, the potatoes are poured out on the grass to dry before they are cut. The pieces average from two to three ounces in weight. These are then planted in rows thirty-six inches apart, and dropped from eleven to sixteen inches in the row. We usually plant the early varieties closer in the row than the late varieties. The late varieties such as the Green Mountains, Kings and Burbanks are planted from May 15th to June 1st, and the early varieties planted later when grown for seed. Early varieties, planted for the summer market, of course, are planted as early in the spring as the weather and soil conditions will permit.

The potatoes are sprayed as soon as bugs appear. If no bugs appear, as has sometimes been the case, spraying is delayed until the buds begin to set unless there be evidence of early blight. Four pounds of white arsenate, or two pounds of Paris green are added to fifty gallons of bordeaux mixture which is the capacity of our spraying machine. Bordeaux mixture is used alone if there are no bugs. We usually make two sprayings during the summer and more if necessary.

A farmer growing potatoes for seed for spring delivery should provide an outdoor cellar, preferably built into a hill side with ample covering to insure against freezing and with ample ventilation to keep the cellar dry. Two such cellars at this station, built out of stone and concrete, are giving very satisfactory service. Basement cellars are usually unsatisfactory on account of their uneven temperature.

POTATOES AS FEED

A. D. WILSON

We are often asked about the advisability of raising potatoes as a feed crop for livestock. Generally speaking, this is not advisable in Minnesota. Potatoes have considerable feed value and of course the culls and surplus potatoes should always be fed, provided there is no better use for them; and naturally in considering whether or not one should actually plant potatoes as a feed crop it is necessary to consider several points.

First, the average yield of potatoes compared with other crops. Second, the feed value of an acre of the various crops, and Third, the labor required in the production of a crop. We assume that there is no one who would think of growing potatoes as a feed crop where corn can be successfully raised as a grain crop, because certainly potatoes cannot compete with corn in production of feed. Where one might think of growing potatoes as a feed crop would most likely be in the northern part of the state where potatoes are an especially productive crop and where corn is not grown extensively because of the short season. In most of the potato growing sections, such root crops as rutabagas, mangles, or stock carrots do exceptionally well and are preferred for feeding purposes to potatoes.

Table No. 1. Average yields of some common crops in Minnesota.

	10 Year Average Yield per Acre	10 Year Average Yield	Total Nutrients Per Acre
Potatoes.	bu. 103	lbs. 6180	lbs. 1,057 lbs.
Corn.....	33.7	1887	1,617 lbs.
Barley....	24.6	1180	937 lbs.

It will be noted from the above table that there is more than three times as much weight per acre produced by potatoes as the average yield of corn, and more

than five times more weight than is produced by the average yield of barley. Potatoes, however, contain a large percentage of moisture. The real feed value of potatoes is better shown by the total nutrients, the figures in the last column of the above table. It will be noted that even here the potatoes produce more nutrients than barley but only about two-thirds as much as corn. Corn, however, is not a generally safe crop in the principal potato growing sections of Minnesota and in these sections the average yield of potatoes per acre is considerably greater than that given in the above table. Elsewhere in this annual will be found a report from the North Central Experiment Station at Grand Rapids showing that the average yields of potatoes at that station for five years have been from 300 to 350 bushels per acre, and this, of course, would materially change the comparison as shown in the above table.

However, the yield per acre is not a very satisfactory way of comparison. As a rule there are many idle acres of land in the state. The factor that limits the total production is usually the question of labor. Consequently, a determination of the most profitable crops to grow must be based to a considerable extent on the labor required to produce each crop. The following table will be found useful in comparing the real merits of crops on this basis:

Table No. 2. Labor Required to Produce Crops.

Minnesota Experiment Station Bulletin No. 157.

	Hours Man Labor per Acre	Hours Horse Labor per Acre	Nutrients Produced Per Hour of Man Labor
Potatoes..	44.4	75.	23.8 lbs.
Corn.....	26.2	54.2	61.7 lbs.
Barley....	12.8	29.9	92.2 lbs.

The figures used in the above table, taken from Minnesota Experiment Station, Bulletin No. 157, are as accurate as any data we have on labor requirements and crop production. They are based on averages carefully taken on a large number of farms covering a number of years. It will be noted that, roughly speaking, twice as many hours of horse labor are required in the production of these crops as of man labor. Consequently, in arriving at the figures in the last column, namely, the nutrients produced per hour of man labor, we have used only the man labor and have ignored the horse labor entirely, as to have included it would have complicated the table and would not have materially changed the results. To get the figures in the last column, we simply divided the nutrients produced per acre, as given in Table No. 1, by the number of hours of man labor. This makes it very plain that with average yields, the potato crop is not an efficient crop in the production of food nutrients.

This table is also of interest in a comparison of corn and barley. Corn not being generally well adapted to the northern section of the state, where a greater portion of potatoes are grown, barley becomes a valuable grain feed. Because barley yields less than corn, it is generally considered greatly inferior to corn as a feed crop, yet when compared on the basis of nutrients produced per hour of labor it shows up very favorably. Because barley is better adapted to growth in the potato sections than corn, a comparison between barley and potatoes as crops for the production of feed may be considered fair. In Table No. 2, it will be noticed that barley produces almost four times as many pounds of nutrients per hour of man labor as do potatoes.

In some of the European countries, where farms are rather small and intensive systems of culture are necessary, potatoes are grown to some extent for feed, the larger, coarser and heavier

yielding varieties being used. It is entirely probable that many northern Minnesota farmers if they attempted to produce potatoes for stock feed could by using the coarse varieties of potatoes produce from 200 to 400 bushels per acre with reasonable certainty, and while this would not be an economical means of producing feed as compared with corn or barley, it would enable one to produce more food nutrients per acre, and in some cases where only small fields are open this might be desirable.

Cost of Production

Labor per acre, of course, is not the only important consideration in crop production. Rent and seed costs, and other factors must be considered. Minnesota Experiment Station Bulletin No. 179 gives us some interesting figures on the cost of producing farm products where all items of cost are considered. The following figures are taken from this bulletin and show the average cost per acre for the five years, 1913 to 1917 inclusive. Present costs would be higher. Nutrients produced per dollar:

Table No. 3. Nutrients Produced Per Dollar

	Cost per Acre	Nutrients produced per dollar of cost
Potatoes.....	\$45.37	23.3 lbs.
Corn.....	19.28	83.8 lbs.
Barley.....	15.81	59.2 lbs.

The above table shows that even when all of the costs of production are included potatoes are by no means an efficient crop in the production of feed as compared with other crops. Barley produces about two and one-half times as many pounds of food nutrients per dollar as potatoes and corn nearly four times as much. Of course, if the yield of potatoes were run up to 300 bushels per acre, this would make the potato crop slightly more efficient than the barley crop but still somewhat less efficient than the corn crop.

Feeding Potatoes

Potatoes are generally fed to either cattle or swine, and they are fed both raw and cooked. Experiments seem to indicate that potatoes are from 25% to 35% more efficient as feed when cooked. The question as to whether or not they should be fed cooked would, of course, depend on the fuel and labor available and their cost. According to "Feeds and Feeding" by Henry & Morrison, cows should not be fed more than 30 to 35 lbs. of cooked potatoes daily and somewhat less of raw potatoes. According to numerous tests made in feeding potatoes to swine, as reported in "Feeds and Feeding" it seems that from 4½ to 5½ lbs. of raw potatoes are required to take the place of a pound of corn, and that from 3½ to 4½ lbs. of cooked potatoes will take the place of a pound of corn.

It would seem fair from the above figures to assume that 5 lbs. of raw potatoes could as a general rule be considered equal to one pound of corn, that if potatoes were fed cooked in all probability the cost of cooking would be fully equivalent to the gain. On this basis we have constructed the following table, which may be useful in comparing the real merits of feeding or selling potatoes:

Table No. 4. Feeding Value of Barley and Potatoes Compared with Corn at Various Prices

Shelled Corn Price per bu. 56 lbs.	Barley Feeding Value per bu. 48 lbs.*	Potatoes Feeding Value per bu. 60 lbs.*
\$0.50	\$0.38	\$0.11
.60	.46	.13
.70	.54	.15
.80	.62	.17
.90	.69	.19
1.00	.77	.21
1.10	.85	.24
1.20	.92	.26
1.30	1.00	.28
1.40	1.08	.30
1.50	1.15	.32

* NOTE—Barley is generally considered as worth 9-10 as much per pound as corn. Hence, we took 9-10 of 48, or the equivalent of 43.2 pounds of corn, or 77% of a bushel of corn. The value per bushel is therefore figured at 77% of the value of a bushel of corn.

** Five pounds of potatoes are assumed to be worth one pound of corn. A bushel, or 60 pounds of potatoes, is worth as much as 12 pounds of corn. Therefore, a bushel of potatoes is worth 12-56 or 3-14 as much as a bushel of corn.

Use of Culls and Surplus

This article is written merely with the thought of presenting some of the facts concerning the real merits of crops for the production of feed. It, of course, does not contemplate discrediting potatoes as a feed when one has a surplus that he cannot dispose of to advantage, or has culls that are unfit for market. Such potatoes, of course, should be fed and be fed so as to give the best possible returns under the conditions existing. It is possible that the system of converting surplus or cull potatoes into silage, as discussed in another article in this annual, may work out profitably. At present it seems that the labor involved would make this practice rather questionable as a general thing. However, if one has stock and is so equipped that he can handle potatoes, it may often be better for him to feed his potatoes on the farm than to help in glutting the market or selling them at a price below their real feeding value.

Grading Potatoes

There has been much opposition to the grading of potatoes, as recommended by the Bureau of Markets of the United States Department of Agriculture. It is probable that the matter of screens and regulations concerning the grading will soon be worked out in such a way that the opposition will be overcome. It is my honest conviction that if our regulations concerning grading were more strict it would be in the interest of both potato producer and consumer. It seems to me that it is safe to assume that nothing but really good potatoes should be put on the market. It is doubtful if the food

value of the poorer grades of potatoes is sufficient to really pay for the cost of shipping and handling. When the poor potatoes are left mixed with the good ones, naturally the producer gets enough less for the good potatoes he sells to pay the middlemen for the cost of handling the poor ones.

Another factor of importance in my judgment is this: housewives will not use potatoes as freely when they have a poor lot of potatoes to peel and prepare as they

will when they have a good lot. Producers are interested in consumers using a maximum amount of potatoes. A greater use of potatoes can be encouraged better by furnishing potatoes of good quality than by any other means. Consequently, we believe that potato growers will generally be much better off if they will grade their potatoes carefully on the farm and keep and feed on the farm all of the poorer grades, and put on the market only those that are really good table stock.

COST OF PRODUCING POTATOES IN MINNESOTA IN 1919

P. E. CLEMENT, MOORHEAD, MINN.

For the purpose of securing an average estimated cost of producing potatoes in Minnesota, a survey was made in six of the important potato-growing counties in northern Minnesota. Two districts are represented—the Red River Valley and the cut-over section. Complete estimates were received from twenty-three representative growers.

Farmers were asked to give, to the best of their judgment, the actual costs of the various operations included in potato production. Estimates were based on 1919 prices and were made on an acre basis. The items of expense included: rent, seed, fertilizer, cutting seed, the various operations of tilling the soil, spraying, digging, picking and hauling to market. Yields, and the selling price of the crop were also ascertained. Twenty-three representative farmers sent in complete estimates.

The averages deduced from these estimates are not given here with any claim that they represent accurate costs of potato production. Almost none of the twenty-three farmers had the items of expense recorded, and had to depend upon memory and estimates. There was a wide variation in some of the items. A study of the tabulated returns leads us to believe the averages to be very fair for all the counties represented, and they are given here as a basis by which other growers may gauge their operating costs.

Thirteen of the twenty-three growers applied manure and secured an average yield of 106 bushels. Four applied commercial fertilizer and secured an average yield of 156 bushels. Four applied no fertilizer and secured an average yield of 84 bushels.

The cost per acre varied from \$31.10 to \$70.50 with an average cost of \$53.94. The cost per bushel varied from 25½c to 77c with an average cost per bushel of 47.3c. The average yield per acre was 113 bushels.

The average estimated costs of the various items were as follows:

Rent.....	\$ 5.00
Seed *.....	11.10
Treating seed.....	.69
Fertilizer, barnyard manure.....	8.30
Plowing.....	2.43
Planting.....	1.60
Harrowing.....	.956
Discing.....	1.25
Cultivating (3-8 times).....	3.30
Spraying for bugs (2.1 times)	
Labor.....	.90
Material.....	1.44
Digging (horse).....	2.50
(hand).....	4.50
Picking.....	6.11
Hauling to market.....	3.86
113 bushels	
Average 4 miles	
Total cost.....	\$53.94

*—The average amount of seed used was 11.7 bushels.

The average price at which the crop was sold was 73c per bushel, making a profit per bushel of 25.7c above the cost of production, and an average profit per acre of \$29.00.

Four farmers report a selling price far below any market quotations of the past three seasons. If their estimates were omitted, the average profit for the remaining seventeen would be 38.7c.

This survey emphasizes some very interesting facts of production.

The grower who had the highest per acre cost, \$70.50, had per bushel expense of 25½c. This is the lowest of the twenty-three growers. The grower who reports a per acre expense of \$31.10 had a per bushel cost of 52c.

Comparing the two reports, we find that the first grower, after paying \$70.50 for the costs of production made a profit on any price he might receive above 25½c per bushel. The other farmer growing potatoes at an expense of \$31.10 per acre, must lose on any price below 52c per bushel. This is from the grower's

standpoint, the principle reason for working for increased yields. A large yield, even though produced at a high per acre cost, decreases the cost per bushel, and greatly lessens the liability of loss.

Another noticeable fact is the estimated cost of treatment for disease, which is sometimes regarded as too great an expense. The average estimated cost for this item is 69c per acre, or about the price of one bushel of potatoes per acre.

One grower who regularly plants 160 acres, has kept accurate data and because of its accuracy we give his figures here:

Seed.....	\$15.32
Man Labor.....	23.74
Horse Labor.....	4.17
Tractor Labor.....	5.24
General Repairs.....	.56
Paris Green.....	1.47
Sacks.....	9.78
Incidentals.....	4.46
Pro-rata overhead.....	10.35
 Total.....	 \$75.05

The cost of production per bushel was just about 50c, and the average yield was 147.5 bushels.

ADDITIONAL FACTS ON COST OF PRODUCING POTATOES

BY EDITORS

It is important that producers know what it costs them to produce the products they are raising for sale. The above article by Mr. Clement shows that the estimated costs by farmers of producing potatoes vary greatly, and also that low costs per acre may mean relatively high costs per bushel.

In 1902 Professor W. M. Hays, then of the Minnesota Experiment Station, saw the need of reliable data on cost of production. He established in co-operation with the U. S. Bureau of Statistics and several Minnesota farmers, three statistical routes for the purpose of finding out as nearly as possible the exact costs of producing crops on Minnesota farms. The routes were located in three typical farming sections, namely: Southwestern, Southeastern, and Northwestern Minnesota. Each route included from eight to twelve farms and a statistical agent who made the rounds of the farms every working day in the year and secured from them the exact facts as to work done the preceding day and to what enterprise or enterprises this work was devoted. Every item of cost was recorded; such as man and horse labor, feed, seed, board of

men, twine, threshing, land rent, interest' depreciation, etc.

This work has continued up to the present time and several reports have been issued on it in the following Minnesota Experiment Station bulletins: No. 97, 117, 124, 145, 157, 161, 162, 173, 179. These bulletins furnish a most interesting and reliable study of the average costs of producing farm products. The figures given do not represent accurate costs on any one farm but rather averages which are useful chiefly for comparison and study.

It is natural that costs of production will vary from year to year and from farm to farm with yields; cost of labor, rent, machinery, seed, feed, etc. Those in charge of this work have recognized these variables and to make their work more helpful have shown where possible hours of man and horse labor required as well as cash costs.

The following table taken from the Minnesota Experiment Station bulletin No. 179, which reports costs of production on the statistical routes for the five years, 1913 to 1917, inclusive, will be found helpful:

Average Cost of Producing Potatoes for Five Years 1913 to 1917 Inclusive Machine Production

Item	Total acreage 5 years	Man hours per acre	Horse hours per acre	Cost per acre
Seed	442.61	.....	.....	\$11.60
Manuring	604.89	2.25	5.22	0.98
Plowing	823.74	2.64	12.39	1.91
Disking	318.59	1.52	6.12	1.07
Harrowing	442.61	1.33	5.07	0.85
Sorting Seed	98.06	1.59	.....	0.28
Cutting	435.45	6.4	.....	1.03
Treating	91.6	0.87	.....	0.13
Hauling Seed	29.86	1.01	0.87	0.26
Planting	442.61	2.86	4.97	1.07
Cultivating	442.61	6.73	14.0	2.93
Weeding	96.94	0.62	1.25	0.23
Spraying	441.35	1.04	1.75	0.37
Digging	427.14	3.3	10.22	1.86
Picking up	105.75	5.73	.....	1.20
Picking and hauling	113.94	6.26	6.49	2.07
Sorting	28.11	2.74	.....	0.47
Marketing	289.45	7.19	9.74	2.82
Spray material	348.06	.....	.....	0.69
Picking, cash	231.7	.....	.....	5.37
Machinery cost . . . . .	.....	.....	.....	2.43
General expense	454.57	.....	.....	1.55
Land rental . . . . .	.....	.....	.....	4.20
Total . . . . .	.....	54.08	78.09	\$45.37

The above figures agree quite closely with the estimates given by the several farmers reporting to Mr. Clement. These figures are somewhat lower than the farmers' estimates, but it must be remembered that they cover five years 1913 to 1917, during which time costs were lower than in 1919, the year covered by the farmers' estimates.

It is interesting to note in Mr. Clement's report that the lowest cost per acre represented the highest cost per bushel. This fact indicates some of the difficulties that would be met if the unwise attempt (sometimes talked of) were made to fix prices on the basis of cost of production plus a reasonable profit.

NO DETERIORATION IN AGRICULTURE OF AMERICA

SECRETARY DAVID F. HOUSTON, U. S. DEPARTMENT OF AGRICULTURE

Address Before the National Association of Commissioners of Agriculture in Chicago, November 11, 1919.

"It is still true that the field of distribution presents to the farmers more difficulties than any others. The problems are of long standing, but only recently has the thought of those responsible for leadership been definitely directed to them and have agencies been created systematically to consider and to assist in solving them. Six years ago the present Bureau of Markets began its work as a small office with a very limited appropriation. Since then a few states have erected similar machinery.

Advance of Agriculture

"The field of production has for a longer time been more systematically exploited, and although much remains to be done the results for the Nation have been significant and of large proportions. In view of the facts it is singular that the notion should still be disseminated that that American agriculture has been deteriorating, and that there is ground for pessimism about the future. It is true that the production of some of the staple commodities has not kept pace with population, but this in itself may be of little significance. The advance in agriculture has revealed itself not so much in the expansion of the staple commodities as in a greater diversity of products, in the appearance of new crops, in the rise of minor crops to large proportions, and the availability of supplies throughout the year. But even in reference to the staple products as measured by one important test there has been a very marked upward movement. The yield per acre of crop production to the United States has gradually increased. The average rate of this increase for the past 25 years has been small, it is true, being only one-half of 1 per cent a year, but the aggregate results have been enormous. This up-

ward trend is not readily observed in yields from one year to another, owing to the wide yearly variations caused by the differences in seasons. But when averages are obtained for a series of years it is readily observed. During the seventies and eighties, when there was a vast expansion in farm area in the West, and crops were grown on a more extensive scale, the tendency of yields was downward. Since the early nineties, however, it has been upward. For the 10 years ending with 1890 the average yield per acre of wheat in the United States was 11.8 bushels; for the 10 years ending in 1918 the average yield was 14.8 bushels, or an increase of 25 per cent. In the first period the average yield of corn was 23.4 bushels; in the second 25.8, or an increase of 10 per cent; of oats, 25.9 in the first period; in the second, of 32.2, an increase of 24 per cent; of potatoes, 72.9 bushels for the first period; and 96.8 for the second, an increase of nearly 33½ per cent. Cotton, notwithstanding the ravages of the boll weevil, increased from an average of 169 pounds in the first period to 175 pounds in the second, an increase of 3½ per cent. All other field crops have likewise improved in yield, the average for the 10 years ending in 1918 being 16 per cent greater than that for the period ending in 1890. This tendency is general throughout the Union. It is not due to the shifting of production. For example, in the older State of New York, the increases for the two periods were as follows: Corn, 24 per cent; wheat, 44 per cent; oats, 21 per cent; barley, 24 per cent; buckwheat, 43 per cent; potatoes, 30 per cent; hay, 10 per cent; weighted average of all, 18 per cent. The facts for New England are even more striking and significant. For the six states the weighted average increase for all field

Going Up!

Nation's Average Acre Yields

	10 Years Ending 1890	10 Years Ending 1918
Wheat.....	11.8 bu.	14.8
Corn.....	23.4	25.8
Oats.....	25.9	32.2
Potatoes.....	72.9	86.8
Cotton.....	169 lbs.	175 lbs.

All other crops, 16 per cent.

Room for large improvement still exists, but

There is no cause for pessimism.

American Agriculture is *not* on the decline.

crops in 1909-1918 over 1881-1890 is 26 per cent, and over 1866-1875, 25 per cent.

"The same tendency holds in most civilized countries. If we compare the average wheat yields per acre in the 10-year period 1891-1900 with those in the 10 years 1901-1910, we find the following increases: United Kingdom, 6 per cent, or from 30.1 bushels to 31.9; the Netherlands, 19 per cent, from 27.7 to 33; New Zealand, 28 per cent, from 24.6 to 31.5; Sweden, 14 per cent, from 24.2 to 27.6; Germany, 23 per cent, from 23.6 to 29.1; Ontario, 12 per cent, from 19.4 to 21.8; France, 8 per cent, from 18.1 to 19.5; Hungary, 3 per cent, from 17.3 to 17.8; Manitoba, 7 per cent, from 17 to 18.2; Japan, over 2 per cent, from 17 to 17.4; Roumania, 21 per cent, from 14 to 16.9; the United States, 8 per cent, from 12.9 to 13.9; India, 16 per cent, from 9.7 to 11.3; the Caucasus, 18 per cent, from 9.5 to 11.2; and Russia, 14 per cent, from 8.3 to 9.5. The yield per acre is the lowest in countries which have been expanding most rapidly and where extensive systems of agriculture with cheap land and dear labor prevail.

Some Agricultural Fallacies

"These figures should disprove the fallacy that in point of productivity American agriculture is on the decline and that we are in sight of the limit of production. It might be interesting to discuss other equally fallacious notions, such as that we need an unlimited number of farmers, that agriculture is not a business which requires the expenditure of capital and labor and must show a profit, that the remedy for an assumed shortage of production is a back-to-the-land movement, that the American farmer has been ignored by the Government, or that it can solve all the problems of production and distribution. The Nation does not need and can not have an unlimited number of farmers unless it is to return to the old basis when the farm was self-sufficient and produced little or no sur-

plus. It should have, and in the long run will have, just as many farmers as will produce what the world will take at a profitable price. Farming must pay and rural life must be made attractive and healthful, schools with their instruction properly related to rural life must exist, good roads be provided, and adequate medical, hospital, and sanitary arrangements be developed. When these conditions are met, the problem will have been solved and the Nation need not worry about the number of its farmers or the requisite supply of materials for food and clothing.

American Farmer Not Ignored

"Of course, the American farmer has not been ignored either in legislation or in machinery for furnishing him practical assistance. I need only refer to the Federal enactments of recent years, such as the changes in the national banking law making possible loans on real estate, the farm loan system, the Smith-Lever Act, the grain standards and cotton standards laws, the Federal warehouse, and the good roads measures, and not to speak of the State departments of agriculture, the great land-grant colleges of the Nation, and the Federal department. It is a simple fact that this Nation has more beneficent legislation for agriculture than any other country and agencies actively assisting the farmer which in point of personnel, support and range of activities, exceed those of any other three nations in the world combined.

"One of the objectives of all good farmers and of the agricultural agencies assisting them is to promote increased yields along economic lines by the further application of scientific knowledge and the adoption of improved processes. The path of progress is pretty well charted and the forces are moving along it with gratifying speed.

"There has been no such full consideration of the policy which should be pursued in reference to the extension of the farm area by the appropriation and cultivation

The United States Has—

more beneficent legislation
for agriculture

and agencies actively assisting the farmer, which in point of personnel, support, and range of activities, exceed those of any other three nations in the world combined.

—*David F. Houston,*
U. S. Secretary of Agriculture.

of unused public and private lands. Since the Nation now retains but little land of ready availability, agricultural expansion will result mainly from efforts to utilize and to increase the productivity of farm lands now owned by individuals, corporations, and States.

"This situation raises a number of important questions: How rapidly should new areas be developed? What means should be employed to bring new lands into use so that settlers may achieve success, employ sound methods of husbandry, and establish a wholesome community life?

Extending Farm Area

"In considering the rate of extension of the area in farms, it is important to recognize that the expansion of the Nation's agriculture is limited by the supply of labor and capital available for use in agriculture as distinguished from other uses, rather than by the scarcity of undeveloped lands. It is true that in general the best land is in cultivation, but without question much of the remainder can be tilled when the Nation reaches the economic stage which would justify its utilization.

"There are numerous fallacious opinions with respect to the need of extending the farm area. Many people, noting the prices prevailing for farm products, demand increased production and insist that the remedy lies in an immediate and rapid expansion of the farm area. Others, observing large areas of unused land, deplore the great waste of our resources. Still others explain the movement of population from rural districts to cities by the nonavailability of land, which they attribute to land monopoly, speculation, and other evils. However, the demand for farm products, unlike the demand for manufactured articles, does not expand rapidly to meet a large increase in supply. There is a tendency toward an equilibrium between urban and agricultural industry. If too much labor and capital are diverted from farming, the relative prices, and consequently the relative

profits, of agricultural activity will increase, and there will be a tendency toward agricultural expansion. If this expansion is excessive, however, relative prices and profits in agriculture will tend to decrease and the industry may suffer depression. The inelasticity of demand for agricultural products sets a very decided limit at a given time to the increase of population and capital engaged in agriculture.

Danger in Fluctuations

"It is not in the interest of the producers or of the consumers to have large fluctuations in the quantity of farm products. There is always danger of glutting the market and of serious loss. The aim rather should be to secure a steady flow of commodities of sufficient volume to supply an increasing demand at prices which will yield the farmer a decent wage and a fair profit on his investment. There is reason for believing that for some years before the outbreak of the World War, the growth of urban communities had been out of proportion and that a tendency toward agricultural expansion had set in. This tendency was intensified by the war and, consequently, a considerable rapid development resulted. This is revealed in certain data for the years 1909, 1914, and 1918. We have no available statistics of total land in farms for all the dates mentioned, but the acreage in crops will show the general changes. The area devoted to 19 principal crops increased 7.7 per cent from 1909 to 1914, and 10.1 from 1914 to 1918. On the other hand, the estimated population increased only 8.8 per cent from 1909 to 1914, and 6.6 per cent from 1914 to 1918. The crop area per capita, therefore, was 3.28 acres in 1909, 3.22 acres in 1914, and 3.33 in 1918, a decrease of 1.8 per cent from 1909 to 1918, but an increase of 3.4 per cent from 1914 to 1918.

Large Increase in Area Probably Unwise

"This expansion has probably resulted in part from the use for crops of land

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This, Secretary Houston of the United States Department of Agriculture, believes will contribute to sound farm conditions in America.

normally devoted to other purposes, especially for pasture. However, it is reflected not only in an increase in the per capita production of nearly all the important crops, but also, according to a recent report, in the number of cattle and swine per capita. Moreover, estimates of the production of milk, eggs, and poultry indicate an increase in the per capita production of these commodities during the war. In view of these facts, it probably would be unwise to stimulate a large increase in the acreage of farm land at the present time, especially as such an increase would have to be effected by utilizing land which is inferior or which would be made available at a heavy outlay of capital for drainage, irrigation, or clearing. Apparently, therefore, American agriculture should consolidate the gains already made, prepare for the period of competition which is to be expected with the return of normal world conditions, principally by increasing by sound and economical methods the productivity of lands already under cultivation, and utilize the services of the most experienced and judicious agricultural leaders in determining where, when, and how to bring into cultivation and develop public and private unused land.

Study of Unused Land

"The best experts of the Federal department and of the agricultural colleges should make a careful study of the possibilities of utilizing land not now devoted to agriculture. In respect to the 200,000,000 acres of cut-over land, 60,000,000 acres of land needing drainage, and 30,000,000 acres which might be irrigated, there is great variation from district to district as to the possibility of economic use. Distinctive regions should be fully studied with a view to assemble all existing data on productivity, the cost of making the land available, present tenure and prices, the type of agriculture best adapted to the conditions, the possible returns, the minimum size of farms capable of supporting families in reasonable comfort, the minimum equipment needed in

**Secretary Houston
says:—**

**Farming must pay.
Rural life must be
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**Schools with in-
struction properly
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**Good roads must be
provided.**

**Adequate medical,
hospital, and sani-
tary arrangements
must be developed.**

the beginning of settlement, sources of credit, and marketing and transportation facilities.

"At present various private agencies are engaged in promoting land settlement. Many of them are honest in intention, promise, and practice; others keep within the letter of the law, but through exaggeration and indirection of statement create false impressions in the mind of the settler. Many violate no canon of fair business practice, but their interest is in profits and they do not pursue a policy calculated to develop a profitable and wholesome community life. There are a few which have devoted careful studies to the conditions of successful settlement and have developed their business with a view to the settlers' progress and success. Practically all these agencies, however, are seeking to realize as high a price for their undeveloped holdings as possible, and the settler is compelled to face the problem of adjustment to pioneer conditions while carrying a burden of land value which often represents in part the capitalization of a future increase in earning power.

"The intending settler of small means is rarely able to distinguish between the good and bad methods of selling land in new regions. The more unscrupulous the land company the more lurid are its advertisements and the more extravagant its promises. Settlers often are induced to invest their all in land not suitable for successful farming, to purchase more land in relation to the capital available for development than they should, or to undertake projects the cost of clearing or reclamation of which will prove to be prohibitive. The results in many instances have been tragic failures after years of incredible hardships, waste of capital and of human lives, discouragement of intending settlers, and injury to the business of legitimate and well-meaning land agencies.

Aid for Farm Seekers

"It would be desirable if governmental agencies, by systematic aid, should fur-

\$1,500,000,000

The estimated value of commodities marketed every year by farmers' co-operative associations in the United States.

Federal and State government must omit nothing to promote helpful co-operative associations

—*Secretary Houston,
U. S. Department of
Agriculture*

nish reliable information to those seeking farms, should take particular pains, through their agricultural machinery, to give new settlers very special assistance and guidance and, where conditions are favorable, should aid in the development of well-considered settlement plans.

Farmers Assume Main Tasks

"It is, of course, true that in the field of production, as well as in the field of distribution, the farmers of the Nation must assume the main tasks of improvement. The most that the Government can do is to create favorable conditions under which production and distribution may take place, to see that the channels of distribution are open and that abuses do not exist, and to furnish all possible aid in the way of information and suggestion. The present time is especially fruitful of proposals of a large and novel nature designed quickly to solve marketing problems. Measures have recently been introduced into the Congress proposing a private or a governmental agency of national range, with State and county subdivisions, to supervise, or even to direct, the handling or marketing of the Nation's farm products. The probability is that an undertaking of such character would break down of its own weight. There is no question that everything which can legitimately be done to eliminate waste in marketing and to promote orderly distribution should be done. But the views of the most experienced students of the matter seem to be that we must approach the problem in simpler terms, working along lines which have clearly proven to be feasible, and promote existing tendencies and practices.

Certainly we can proceed further, by State, Federal, and individual action, in standardizing the production, the handling, and the packing of farm products, and in promoting the use of standard containers and proper storage on farms, in transit, and at market centers. We can continue to furnish assistance in the preparation and installation of account-

ing systems, and more extensively and accurately gather and furnish to the farmers of the Nation all pertinent statistical information. I need scarcely emphasize the paramount importance of making available daily to producers facts as to market prices, supplies, and demands. The market news service of the Department of Agriculture has already clearly proven its value. The department now conducts and operates an inspection service on fruits and vegetables at 163 markets. It publishes reports on the supply, commercial movement, and prices of most of the important products and, in co-operation with 14 States, is issuing exchange marketing lists which make known to county agents, breeders, and feeders in these States where surpluses of live stock, feeds, and seeds are to be found. It is estimated that through such service in Iowa alone the farmers made local exchanges with an estimated value last year of a million five hundred thousand dollars.

Help Co-operative Associations

Particularly must the Federal and State agencies omit nothing to promote helpful farmers' co-operative associations. Already within a generation many such bodies have developed and expanded rapidly. It is estimated that such associations in this country now market annually approximately a billion five hundred million dollars' worth of commodities. They are of very diverse forms and size. For the most part, where they have been successful, they have centered their activities on some one product or related products in a given area. The indications are that, with the continued success of these enterprises and with the proper educational effort and direction, they will develop even more rapidly in the future. Through bulletins, news articles, and lectures, the Department of Agriculture has endeavored to stimulate these efforts. It has furnished suggestions for State legislation governing their organization and, in co-operation with 23 States, it has em-

ployed trained specialists to advise extension workers, including county agents, with reference to marketing and organization problems.

Expand Existing Activities

"As I have said, the rational program would seem to be to expand these activities, which have clearly demonstrated their value, to follow the scent, as it were, and to further develop the machinery through which increased assistance may be furnished. There should be in every State one or more trained market specialists of the Department of Agriculture, working in co-operation with the proper

State authority, to stimulate co-operative enterprises and to aid farmers in their marketing work by helpful suggestions as to plans and methods. These experts could very effectively aid the extension workers. County agents generally have the benefit of assistance of specialists in many other lines, but at present they have not the requisite assistance in lines of distribution. They can not be expected to be expert in all agricultural matters or to be omniscient. The department is requesting increased funds to make this extension possible and will take the necessary action promptly if the appropriations are made.

MARKETING FARM PRODUCTS

One of the important questions of the day is that of marketing farm products. This is a very complicated question and is becoming more complicated. It is complicated because so many different persons, so many different operations, and so many different communities are involved. In the old days when a farmer grew most of the things he and his family used and the few surplus products that he produced were marketed locally, usually by him directly, the system was very simple, but with improved machinery, and improved crops and livestock, the production per individual has greatly increased. Likewise, the great development in transportation has made the products of the world in most lines available to everyone, so marketing instead of being a community problem, as it used to be, involves the commerce of the whole world. It is no wonder that it is not more thoroughly understood than it is. Much is being done to study and systematize marketing and real progress is being made, and of course, there is

much more improvement that can and will be brought about as knowledge of the system and possible improvement increase.

We are publishing below several letters written by Mr. W. L. Cavert, leader in farm management work in the Agricultural Extension Division to the County Agricultural Agents of the state, for their information. These letters, of course, do not attempt to settle the question of marketing but they are a real contribution to the study of marketing and are, we feel, of sufficient interest to Minnesota farmers to warrant their publication here. The tables will be found very interesting, likewise the comments and suggestions made in connection with them.

Prices of Small Grain

The following table shows the eleven years average price of wheat, oats, and barley for the first of each month on Minnesota farms for 1908-1918, as reported by the U. S. Crop Reporter for wheat, oats and barley:

Month	Wheat		Oats		Barley	
	Price per bu.	Per cent of Oct. price	Price per bu.	Per cent of Oct. price	Price per bu.	Per cent of Oct. price
August.....	\$1.33	115.6	\$0.48	123.0	\$0.71	110.9
September.....	1.18	102.6	.40	102.5	.64	100.0
October.....	1.15	100.0	.39	100.0	.64	100.0
November.....	1.18	102.6	.40	102.5	.65	101.5
December.....	1.17	101.7	.41	105.1	.66	103.1
January.....	1.19	103.4	.42	107.6	.68	106.2
February.....	1.23	107.8	.44	112.7	.72	112.5
March.....	1.23	108.7	.45	115.3	.76	118.7
April.....	1.25	118.7	.46	117.9	.78	121.8
May.....	1.35	117.3	.48	123.0	.81	126.5
June.....	1.35	117.3	.46	117.9	.75	117.2
July.....	1.28	111.3	.46	117.9	.70	109.3

The Time to Buy

STOCKERS and FEEDERS

IS IN
NOVEMBER
DECEMBER
JANUARY

Because then the prices run at about the
lowest for the year

The Time to Sell

FAT STEERS

IS IN
MAY
JUNE
JULY
AUGUST
SEPTEMBER

Because then prices run highest, according
to government price reports

The figures of the U. S. Crop Reporter based on farm prices show more of an advantage in holding for the summer market than do the figures showing the average monthly prices at Chicago, for the reason that in the case of the feed crops in particular, there is an occasional year or portion of a year when the price due to local scarcity is materially higher than the Minneapolis or Chicago price would warrant on the basis of the terminal price less freight and handling charges.

In the case of small grain shrinkage from loss of moisture is insignificant after it has passed through the sweat.

Prices of Corn

The following table gives the average farm price for Minnesota, on the first of each month for the eleven-year period from 1908 to 1918, also the monthly price in per cent of the December price.

Month	Average Minnesota Farm Price 1908-1918	Per Cent of December first price
November.....	\$0.69	106
December.....	.65	100
January.....	.66	102
February.....	.66	102
March.....	.68	105
April.....	.73	112
May.....	.79	121
June.....	.80	123
July.....	.84	128
August.....	.89	137
September.....	.87	134
October.....	.83	128

There seems to be no advantage in holding corn after it is ready for shelling unless it is held until the latter part of March or later.

The following table shows the monthly shrinkage of corn based on a ten-year test at the Illinois Station as reported in Bulletin No. 183:

Month	Shrinkage per Month in per cent of November first weight
November.....	1.9
December.....	.9
January.....	1.3
February.....	1.5
March.....	3.0
April.....	3.1
May.....	2.2
June.....	.9
July.....	.5

There is no material loss of moisture after July.

CORN PRICES FOR ELEVEN YEARS SHOW

that there is
NO ADVANTAGE

in holding corn after it is ready for shelling unless it is held until late in March, or even later

Read the reasons why in the accompanying article

The following table shows the monthly price on a percentage basis, and also the selling price for each month necessary to offset shrinkage:

	Monthly Price of Corn 1908-1918 Inclusive on percentage basis with Dec. Price 100%.	Starting with 100 bu. on Dec. 1 the bu. that will be left 1st. of each month.	Necessary Selling price to offset shrinkage in per cent of Dec. 1 price.
December.....	100	100	100
January.....	102	99	101
February.....	102	98	102
March.....	105	96	104
April.....	112	93	108
May.....	121	90	111
June.....	123	88	114
July.....	129	87	115

CATTLE PRICES BY MONTHS, AND LIVESTOCK MANAGEMENT

The following table shows in dollars and in per cent of the January price, the monthly price of native beef steers on the Chicago market for the fifteen years from 1904 to 1918, inclusive:

Month	Average Price of Native Beef Steers	Per Cent of January Price
January.....	\$7.02	100
February.....	6.97	99
March.....	7.33	104
April.....	7.62	108
May.....	7.79	111
June.....	7.99	114
July.....	8.06	115
August.....	8.04	114
September.....	8.13	116
October.....	7.83	112
November.....	7.75	110
December.....	7.68	109

The outstanding feature of the foregoing table is that January and February are the months of lowest prices, while May to September, inclusive, are the months with the highest prices. In the fifteen years from 1904 to 1918, inclusive, during eight years the lowest prices occurred in February and during four years in January, and only three times during the fifteen years did the lowest price of the year occur in months other than January and February. In the foregoing table, the January price is compared with the price of the following December. If one compared the January price with that for the preceding December, there would be practically no difference between the average for December and for January.

Stockers and Feeders

April and May are the high price months, and January is the low price month with November and December nearly as low. The following table shows the average monthly price of stockers and feeders at Chicago for the fifteen years from 1904 to 1918, inclusive, except for 1915 and portions of 1914 and 1916 when the market was closed on account of foot and mouth disease:

Month	Average Price Per Cwt.	Per Cent of January Price
January.....	\$5.20	100
February.....	5.53	106
March.....	5.90	113
April.....	6.06	116
May.....	6.15	118
June.....	5.89	113
July.....	5.51	106
August.....	5.58	107
September.....	5.59	107
October.....	5.45	105
November.....	5.33	103
December.....	5.34	103

During eight years of the fifteen, the highest monthly price was in May, during four years the highest monthly price was in April and during two years the highest average was made in March. An average monthly price as low or lower than any other month occurred five times in January, three times in December, three times in July, twice in November and twice in October. If one compares the January price with that for the preceding December instead of with that for the following December the January price would be about 8 per cent better than the December price.

Fat Cows and Heifers

The following figures show the average monthly prices of fat cows and heifers at the Chicago market for the years from 1904 to 1918, inclusive:

Month	Average Price Per Cwt.	Per Cent of January Price
January.....	\$4.97	100
February.....	5.08	102
March.....	5.41	109
April.....	5.72	115
May.....	5.97	120
June.....	5.80	117
July.....	5.50	111
August.....	5.45	110
September.....	5.21	105
October.....	5.09	102
November.....	5.07	102
December.....	5.03	101

The Best Market

FOR

Stocker and Feeder Steers
Cows and Heifers

Almost Always Comes

about the time the cattle
are turned out to pasture

*Why Not
Take Advantage
Of This Fact?*

The average monthly price for May was as high or higher than any other month of the year during ten years out of the fifteen. During four years, the March price was higher than that for any other month. The lowest average monthly price occurred five times in December, three times in November and three in January. If one compares the January price with that for the preceding December, the January price would be about seven per cent better than the December price.

Selling Beef Cattle and Buying Feeders

The highest price for fat steers usually occurs from May to September, and the lowest price for feeders and stockers occurs in November, December and January. Therefore, the best policy one year with another would appear to be to buy the feeders in December, January or early February and have them ready for the May or June market. This would seem to be a particularly desirable policy when silage forms a large part of the roughage, as the silage does not deteriorate while shock corn deteriorates rapidly in the late winter and early spring. Where one has stalk fields or other feed that would go to waste, one would usually be ahead to buy his feeders in time to make use of this feed. The buyer who is on the market during the period when range cattle are being freely marketed may have an opportunity to make a better selection than the December and January or early February buyer. However, considerable advantage would be required to compensate for the longer feed.

Marketing Farm Cattle

The cattle sold by the average farmer consist largely of stocker and feeder steers, cows and heifers. Particular attention is called to the fact that the best market for stocker and feeder steers, cows and heifers almost always occurs just about the time that cattle are turned to pasture, and likewise the poorest market occurs in November, December and January. In view of these facts, it would seem wise to strongly emphasize the desirability of making it a policy to sell sufficient cattle on the high April and May market so that those left will have ample pasture instead of a very short bite during the latter part of the pasture season. If in July and August it develops that there is surplus pasture cattle can usually be purchased to good advantage from those who must sell because of over-stocked pastures. In like manner the policy should be to carry only sufficient cattle on to winter feed so that one is certain to have feed to carry them to the good spring market rather than sell on the glutted market of midwinter.

To sum up, it is always better to plan the number of cattle kept so as to have surplus feed in a good season, and sufficient feed in a poor season, rather than to carry so many cattle that in a poor crop year one has to sell cattle at a sacrifice or buy high-priced feed.

In calling attention to such figures as the foregoing one should always at the same time carefully emphasize the fact that average figures contain no guarantee as to the course of the market in a particular year. A farmer who bases his feeding and market practice upon a statistical study of market behavior in previous years is certain to be the gainer over a period of years.

BUTTER PRICES AND DAIRY MANAGEMENT

The following are the average prices of "Extras" at Chicago for the ten years 1909-1918, inclusive:

Month	Average price in cents per pound	Prices in per cent of June Price
January.....	34.1	118
February.....	32.6	113
March.....	31.5	109
April.....	31.7	104
May.....	30.0	100
June.....	28.9	100
July.....	28.8	104
August.....	30.0	110
September.....	31.8	118
October.....	34.0	118
November.....	36.5	126
December.....	38.6	134

The foregoing figures show that October, November, December and January are the high months of the year; therefore, if a farmer is to participate largely in the good market, his cows must freshen early in the fall. However, we incline to the view that with most farmers the maximum profit will be realized if the bulk of the herd freshens at the time that the herd begins to receive winter care. The reason for this is that it has been our observation that when cows freshen in the early fall, they are neglected during the period between freshening and the period of stable feeding with a consequent shrink in milk flow that is not regained.

Attention is called to the fact that during any particular year, the trend of the market may depart widely from average behavior.

AVERAGE PRICES OF HOGS BY MONTHS

The following is the average monthly price of all grades of hogs at the Chicago market for the eleven years 1907-1917, inclusive:

Months	Average price	Monthly price in per cent of January price
January.....	\$6.83	100
February.....	7.11	104
March.....	7.56	110
April.....	7.72	113
May.....	7.62	112
June.....	7.59	111
July.....	7.72	113
August.....	7.77	114
September.....	7.88	115
October.....	7.59	111
November.....	7.07	104
December.....	7.02	103

During the eleven years for which an average is given there are only two in which the January price was not higher than that of the preceding December; but on the basis of the January market compared with the following December, the basis on which the foregoing figures were prepared, there are five years in which the December market was lower than that for January, and six in which the December price was higher than January.

These figures emphasize the desirability of having spring pigs come early, where the farmer has suitable housing facilities, so that they may be crowded for the October market. This would suggest the need of carrying over an abundant supply of grain for summer feed, and also the wisdom of planting as early as possible a field of flint or other extra early corn so as to have it ready to hog off during the latter part of August. The figures would also suggest that if one has pigs

It is probable that with a longer term of years the December price would average slightly lower than that for January.

Early Spring Pigs

crowded for the

October Market

are likely to

BRING GOOD PRICES

because

RECORDS SHOW THAT IN OCTOBER PRICES FOR HOGS ARE USUALLY AT ABOUT THE TOP LEVEL FOR THE YEAR.

This means, though, that the producer must have good housing facilities and carry over grain for summer feeding

that reach a weight during October that will enable them to bring the price of the bulk of the run on the market that the greatest profit will be realized by selling at once unless there should be an unusually wide spread between the price of corn and hogs.

For the farmer who does not have suitable quarters for early farrowing, it would be possible to reach the good spring market by having the pigs come later than usual, but there is some question as to whether the extra cost of production, due to the long winter feed, would not offset the extra price. However, it would seem that it would usually be a bad policy to sell half fat hogs in December and January for lack of feed as an advancing market is the normal proposition for the latter half of January, February and March; and by buying feed one would gain not only the increase in weight, but the extra premium paid for well finished hogs, and also the advantage of an average advance of ten to thirteen per cent in the market between the December and January rush and the March and April market.

Too much emphasis cannot be placed upon the proposition that the foregoing figures deal only with averages and that for a particular year the market may depart widely from its average trend. In this connection, it is well to supplement averages with figures showing the frequency with which the market departs from the average trend. In this connection, attention is called to the fact that

for the eleven years under consideration, there were eight in which the April market was higher than the average price for either the preceding November, December, January or February. And nine years out of eleven in which the October price was better than the average of either the following November or December.

We believe that the farm bureau, county agents, and extension workers can assist farmers materially in planning their farm business by furnishing as full information as possible as to the average trend of markets for the various products.

Egg Prices

The following figures show the ten-year average prices of eggs on the first of the month on Minnesota farms for the ten years, 1909-1918, inclusive, as reported by the U. S. Crop Reporter:

Month	Average price per doz. on first of Month	Price in per cent of April price
January.....	31.1	167
February.....	29.0	156
March.....	25.9	139
April.....	18.6	100
May.....	19.2	103
June.....	19.3	104
July.....	18.7	101
August.....	19.4	104
September.....	21.6	116
October.....	24.5	129
November.....	27.5	148
December.....	30.4	163

PERENNIAL SOW THISTLE*

BY ANDREW BOSS, DIVISION OF AGRONOMY AND FARM MANAGEMENT, AND
R. C. DAHLBERG, DIVISION OF PLANT PATHOLOGY AND BOTANY

One of the most serious weeds in Minnesota is perennial sow thistle, a pernicious weed of long life and abundant seed production. It is in a class with Canada thistle and quack grass. It causes a very considerable annual loss in those areas which are infested, some fields being entirely abandoned because of the weed. Where sow thistle has become established no crop or but a small percentage of a crop may be expected.

As the seeds are very light, they may be carried for miles by the wind. It is therefore of decided value to enlist the efforts of a whole community in the control of the weed.

Weed is Spreading

The entire northwest corner of the state is more or less seriously infested with the weed. Authentic specimens have been received from several counties in the central and southern parts of the state. It is apparently becoming more prevalent with each succeeding year. It is also found on the North Dakota side of the Red River. In Canada it is very abundant and is considered the most serious weed in the Dominion.

The seeds of perennial sow thistle are found in such agricultural seeds as timothy, alsike clover, and red clover and it is difficult to separate them.

How to Recognize the Pest

Plants—The plants are from one to five feet tall, unbranched except near the top where there are several slender branches each bearing one or more flowers. They may be entirely free from hairs on stem and leaves or they may have a few hairs on the stem directly below each flower and also on the green cup-shaped structure partly enclosing the flower. The juice of the plant is milky.

Leaves—The leaves are mostly found on the lower half of the stalk and are from

four to twelve inches long, generally deeply cut but occasionally entire; edged with rather soft spines.

Flowers—The flower heads are from an inch to an inch and a half across, rich yellow in color, much resembling a dandelion flower.

Roots—The plant has underground rootstocks, bearing buds, each bud being capable of producing a new plant. The roots live over from year to year, thus making the plant a distinct perennial.

Seeds—The seeds are rich reddish brown in color, strongly ribbed lengthwise and slightly wrinkled crosswise; slender, not more than an eighth of an inch long. Attached to each seed is a tuft of white silky hair which aids in the distribution.

Time of flowering—Sow thistle blooms in the latter part of June with the majority in flower by the middle of July. Seeds mature in a week or ten days after the flowers begin to open.

Related Forms Not Perennial

Related forms of sow thistle are spiny sow thistle (*Sonchus asper*) and annual sow thistle (*Sonchus cleraceus*). These differ from perennial sow thistle in several ways, chiefly in the absence of rootstocks. Both of these thistles are annuals.

Cultivation Will Win

Eradication resolves itself into two main efforts: (1) prevention of seed production and (2) the destruction of the underground parts.

Prevention of seed Production—Becoming acquainted with the appearance of the plant so as to recognize it by leaf and blossom is necessary. As soon as the first few plants appear in a field or along the roadside, cut off the stems bearing the blossoms so that no seed can be produced. If the weed has made considerable headway, do not under any con-

*Reprint of Circular No. 1, Agricultural Extension Division, University Farm.

LOOK OUT!!

or the

Perennial Sow
Thistle

will

GET YOUR CROP

THOROUGH CULTIVATION

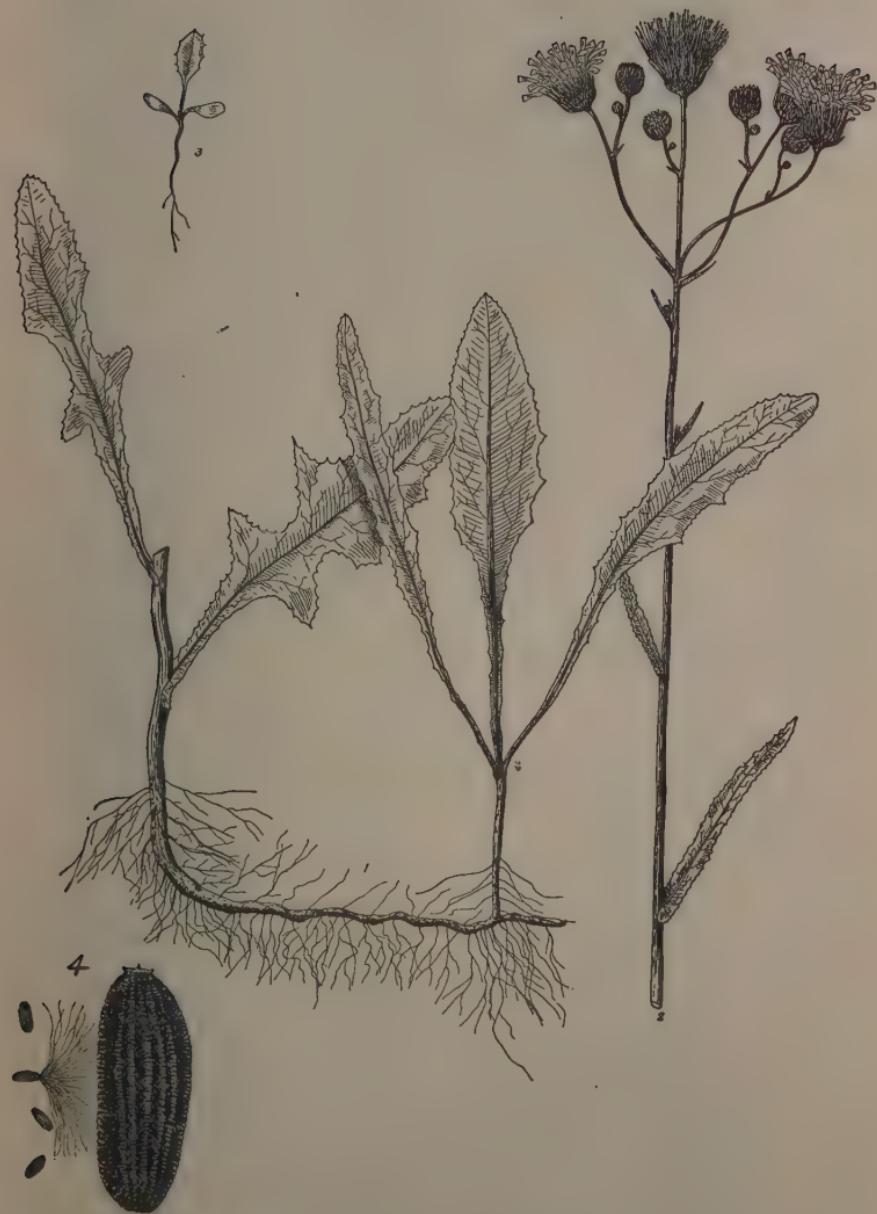
is the

BEST WAY

to

oust the WEED

Read about the pest in the accompanying article



PLANT AND LEAF OF PERENNIAL SOW THISTLE

ditions delay cutting off the stems before the blossoms appear or immediately after, even though no more can be done at the time toward complete eradication.

Complete eradication—Perennial sow thistle yields readily to thorough cultivation. Therefore the adoption of a system of cropping which gives the desired crops and affords an opportunity to give clean cultivation is of prime importance. Two rotations which afford more than the ordinary opportunity for careful cultivation are: (1) Three-year rotation; first year, grain; second year, clover, hay; third year, cultivated crop. (2) Four-year rotation: first year, grain; second year, clover hay; third year, corn; fourth year, corn. In carrying out either of these rotations the field is sown to grain and with the grain clover and timothy seed. The grain is harvested and the next year a crop of clover hay is cut about the first of July. Following the removal of the hay crop the ground is plowed at once, approximately four or five inches deep. The ground is then double disked as needed to keep all green plants from showing above ground until from August 15 to September 1, then

plowed again about tow inches deeper than before and the disking continued as needed to freezing time and again early in spring until corn or potato planting time. Keep the corn or potatoes absolutely free from sow thistle and other weeds, using the hoe if necessary to make the work exceptionally thorough.

The four-year rotation provides another year of cultivated crop which extends the period of clean cultivation, thus giving exceptional opportunity to make the work complete. In the northern part of Minnesota sunflowers for silage may be used instead of corn or potatoes as a cultivated crop. Rye is a good grain to use, since it is harvested early. It may be drilled in the corn about September 1. Work done now and then but neglected for long periods during the rush of other work, accomplishes very little. Only a well-organized plan consistently carried out will win. Not the amount of work, but work done in the right way at the right time counts. Tar paper laid to lap 4 or 5 inches and well weighted down with soil may be used for small spots, or the plants may be dug and the underground parts removed from the soil and burned.

MANAGEMENT OF BEES*

CARE OF BEES IN SPRING

BY FRANCIS JAGER, DIVISION OF BEE CULTURE

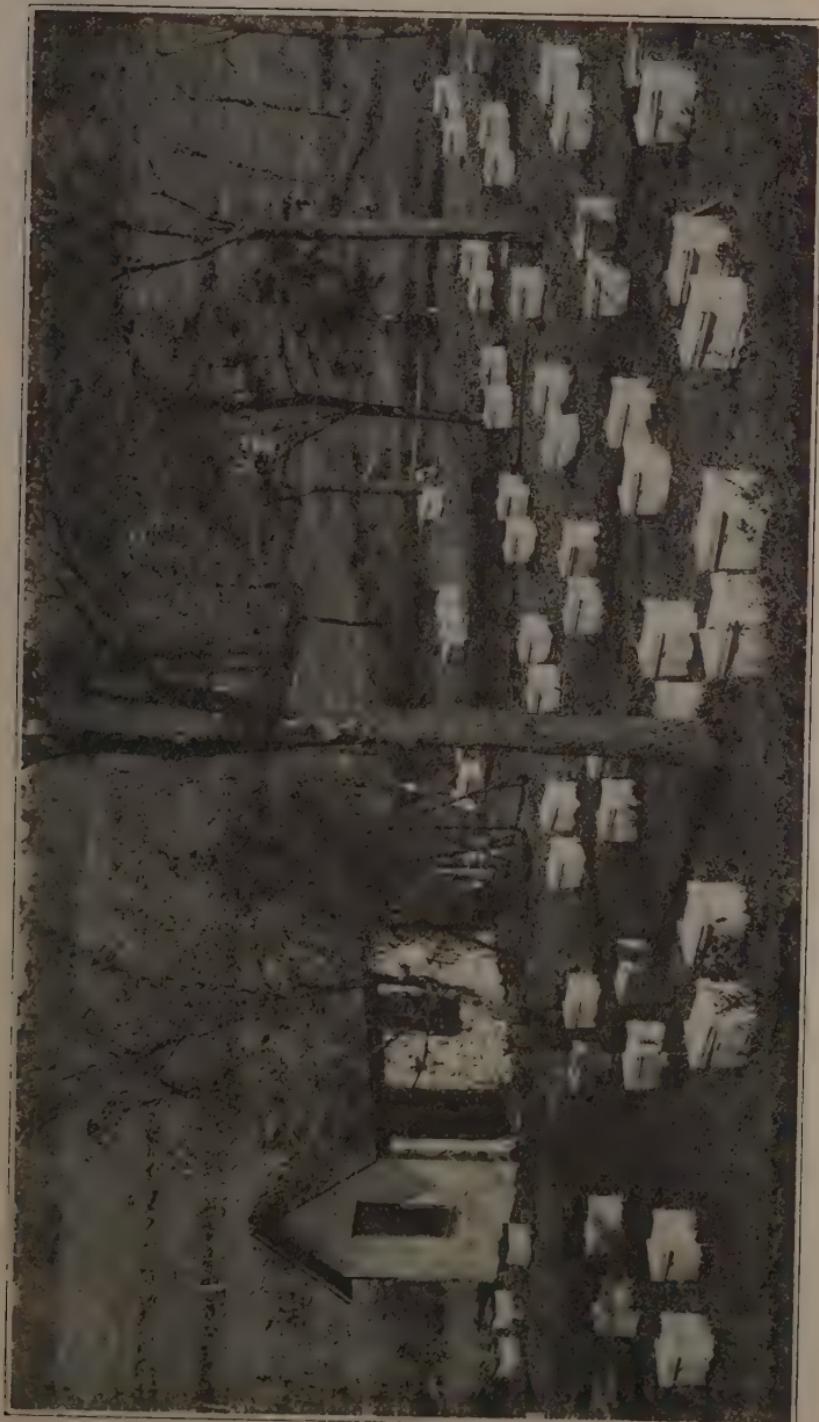
Have young prolific queens; encourage late brood rearing in the fall; winter your colonies in a dry, warm, dark, and quiet cellar; prevent drifting and robbing in the spring; feed your bees at home in the spring; and protect your hives against cold and wind. By doing this you will have plenty of bees to raise a large quantity of brood in the spring; your colony will grow rapidly; and when the honey flow finally arrives, in June, you will have your colonies in the best condition to take full advantage of the crop.

The principal honey flow in Minnesota comes from clover and basswood, during the latter part of June, and the colonies

must build up quickly in the spring to be ready for it. A strong colony of bees will store a large surplus of honey, while a weak one will hardly store enough for its own use. In the willow herb regions of the north, the honey flow comes from five to six weeks later, and medium strong colonies will have time to build up to take advantage of it.

In Minnesota the colonies of bees come from their winter quarters early in April in a rather weak condition and the bee-keeper has only about two and a half months in which to build them up and

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A WELL-KEPT BEE YARD

make them strong for the clover and basswood honey.

Colonies are made strong by large production of brood and young bees. All spring management of bees must tend toward the largest possible production of brood. The beekeeper must constantly bear in mind that the colony will not raise more brood than the bees can take care of. The smaller the colony the less brood it will raise. It therefore naturally follows that factors which decrease the size of the colony will also decrease the production of brood; that a loss of bees from the colony will be accompanied by a proportionate loss of brood, and ultimately the loss of the honey crop.

Dwindling

All causes of death or disappearance of bees in the spring, decreasing the size of the colony, have been summed up under the vague term, "spring dwindling." They may be separated into: (1) Natural death; (2) spring drifting; (3) robbing; (4) cold rainy weather and high winds; and (5) starvation. It is the power of the beekeeper to remove these causes, either entirely or in large part, by wisely applied remedial measures. The result will be strong colonies in June.

Natural Death

Bees die fast in the spring from old age. Bees live from six weeks to seven months or more, in proportion to their activities. The more they rest the longer they live. It follows that bees hatched in September or October will live longer than those hatched in August, and that bees that are perfectly quiet during the winter will live longer than those that are excited. Bees that are hatched late in the fall and are wintered quietly will not die a natural death until after the colony has been made strong by a large production of young bees in April and May.

To secure this result, the beekeeper must have young and prolific queens in his colonies the year before. It is a well-known fact that young queens will sometimes lay eggs until in October. A modern beekeeper will feed his bees late in the

fall with just enough syrup every day to stimulate even his older queens to raise brood late in the fall. He will remove from the hive combs of pollen-laden fall honey and honey dew (black honey) and replace them with clover honey or sugar syrup. From experiments made it is advisable under any circumstances to feed the bees ten or fifteen pounds of sugar syrup the last thing in the fall. He will provide for them a good cellar in which to winter and keep them from excitement during the winter period.

Drifting

Drifting, which causes most harm in colonies of bees, occurs in the spring, during the first flying days after the bees are set out. Bees from many hives, returning from their cleansing flight, club together and enter one or two hives in the bee yard, making them strong in bees but leaving the rest of the colonies weak. To prevent drifting, remove bees from the cellar in the evening, contract the entrances to the hives to a two-bee passage, and face the colonies in different directions. Straight, unbroken rows of hives, an arrangement practiced by most beekeepers in Minnesota, is the worst possible for drifting, and also for a quick spread of foul brood. Colonies should be arranged in groups of three or four. Distinguishing marks should be put on the front of the hives to help the bees in locating their homes. Different colors for the hives are also good guides.

Robbing

Robbing is caused by removing the bees from the cellar on different days, those that have had a flight being in advantage over those just brought out; by the presence of dead and weak colonies in the yard; by exposing honey where the bees can get at it; and by irregular feeding.

To prevent robbing, all bees should be taken from the cellar at the same time, and the entrances should be closed to a minimum. All dead colonies should be removed. No honey should be left accessible to bees outside the hive. Outdoor feeding of syrup, if practiced, must

be constant and in the same place where begun until the bees quit it themselves.

Bad Weather and Winds

Bad weather and high winds will kill bees both outside and inside the hive. The bees perish in the open when taking advantage of good weather to go in search of water, pollen, and honey. Leaving the shelter of their homes they encounter strong spring winds and are blown to the ground, or they roam over miles of surrounding country in search of flowers, when a cloud will cover the sun or the wind will change to a cold quarter or a sudden shower will come up. The chilled bees fall to the ground and perish.

To prevent this, probably the most serious loss of bees, the modern beekeeper will feed his bees at home. Rye flour, scattered on a board with a few drops of perfume will attract bees and make them work on it. Thin sugar syrup, fed in a warm sheltered place, will keep thousands of bees at home and out of danger until they can find natural honey.

Inside the hive, cold will kill bees in spring by lowering the inside temperature and the wind by blowing through the cracks of the hive. The cluster of bees will contract to keep warm and the brood nest will shrink accordingly. As the bees must generate an enormous amount of heat to keep the brood at a temperature of 98 degrees Fahrenheit, they exert themselves and die. The queen stops laying, and even after the weather becomes warm again and the wind ceases to blow it will be several days before egg production will be normal again. In some bee yards the bees suffer many such checks every spring.

To prevent such losses, the apiary in the first place should be located in a sheltered place with either natural or artificial windbreaks against prevailing winds, especially cold winds. The hives should be air tight. The top of the hive should be covered with some insulating material to prevent escape of heat. The cluster of bees should be divided from the cold uninhabited part of the hive by a

division board. The cheapest division board is a newspaper. Lowered down edgeways between two combs until it reaches the bottom board, it is then bent over the frames occupied by the colony and inserted between two combs, reaching again the bottom board on the other side. Being just about the right width, it will enclose the bees in a small, warm, snug compartment where they can breed in comfort. Some beekeepers cover the whole hive with insulating paper or patent insulating board. Others use carpets or sacks. Others use deep telescope covers, which they push down over several thicknesses of newspaper or other insulating material. Individual ingenuity will suggest other means of protecting bees from wind and cold during the trying period of early spring.

Starvation

Starvation of bees in spring will cause the queens to stop laying. There are two kinds of starvation. One is absolute, when the bees have no honey. This means death. The other is relative, when the bees have so little honey and pollen that they can not raise brood.

The wise beekeeper prevents starvation by giving his bees in the spring solid frames of honey from the preceding season, and by feeding them with Boardman or Alexander feeders whenever the weather is such that they can not fly.

PRODUCTION OF COMB HONEY

General Recommendations

- a. Comb honey should be produced only during a strong honey flow.
- b. Comb honey should be removed immediately when finished.
- c. Nothing but A-1 sections should be used with full sheets of thin foundation and three-eighths inch thin bottom starters.
- d. Only strong colonies must be used which have at least eight frames of brood and the brood chamber overflowing with bees at the beginning of the honey flow.
- e. Bait sections should be used in the first super given.

Management of Bees for Comb Honey

Miller plan—Look through your colonies every ten days and cut out every queen cell. Add comb honey supers as soon as the harvest opens.

Natural swarm plan—Put comb honey supers on all strong colonies at the beginning of the honey flow. In due time most of these colonies will cast a swarm. Hive the swarm on foundation or starters (or drawn comb if you have nothing else). Place in the center of the hive one frame of unsealed brood to prevent the swarm from deserting the hive. Place the swarm on the old location and give it all the comb honey supers from the parent colony. Put the parent colony next to the swarm but facing away at right angles. The sixth day after move the parent colony to the other side of the swarm in the same relative position. After another six days move the parent colony at noon to a new location at least ten feet away.

Modified Doolittle plan—Give strong colonies room for work by adding an extracting super as soon as needed. Let them store honey in the extracting super well into the honey flow until the super is three-fourths full. Then on some clear day when the bees are at work move your two-story colony a little to one side. In the vacated place put a bottom board, and on it put the extracting super from the removed colony. In the center of this extracting super, place a frame with some unsealed brood and the queen, after removing the lightest honey comb to make room for it. This is going to be the new brood chamber. Place now on top of it two comb honey supers. Shake from the combs of the removed brood chamber all bees in front of the prepared hive, also all bees that still cling to the box. The queenless and beeless brood is stacked up on top of one of the weak colonies. Proceed in the same manner throughout the strong colonies, giving from three to five supers of beeless brood to weak colonies.

PRODUCTION OF EXTRACTED HONEY

At the beginning of the honey flow, which is also the beginning of the swarming season, when your colony of bees has grown strong enough to fill all spaces between the combs, place on top of the hive a queen excluder and add one extracting super filled with frames of drawn comb or full sheets of foundation. Lift into this super from the brood chamber below all combs containing honey but no brood. Such frames are found next to the walls of the hive. Into these empty places next to the wall move frames of young brood, and replace vacancies by drawn combs or full sheets of foundation. If an occasional swarm issues, hive them as described above in the "Natural Swarm Plan," substituting "extracting" supers for "comb honey" supers.

When the first extracting super is three-quarters full, insert another super next to brood chamber. Add a third super on top if necessary later in the season.

Extracted honey should not be removed from the bees until nearly all cells are capped over and the honey has acquired the proper body. It is best to leave it with the bees for at least two weeks after the honey flow. When ready to remove it, do it by means of the Porter Bee Escape. On account of robber bees it is safest to remove the honey in the evening or at some time when bees do not fly. The honey should be extracted immediately while it is still warm. The bee house where extracting is done must be closed and bee tight, else robbing may cause serious trouble. Extracted combs should be stored in a well closed place and fumigated against the moths once every ten days until freezing weather sets in. It does the combs good to freeze in winter, as cold will destroy the larva of the bee moth.

MAKING CIDER AND CIDER VINEGAR*

By W. G. BRIERLEY, DIVISION OF HORTICULTURE

Sweet cider is easily made and usually can be sold readily if of good quality. Very good quality can be secured by using suitable varieties of apples and by paying attention to several simple but important details in the process of grinding and pressing.

Use Ripe Apples

Apples used for cider should be well ripened, not over-ripe or green. When fully ripe, apples contain the greatest quantity of juice and the sugar content and flavor are generally at the highest point of development. If the apples have developed properly in sugar content and flavor, the resulting cider will be of much better flavor and quality than cider from the same variety, either when green or when over-ripe. A fairly accurate estimate of the value of any apple variety for cider-making is found in the quality of the apple itself. Varieties with a pleasant, attractive flavor and either sweet or sub-acid will make a cider of similar character, whereas a variety characteristically sour, puckery, or flat will yield a cider of the same nature.

Recent investigations have shown that the best varieties for sweet cider are Anisim, Charlamoff, Lowland Raspberry, Okabena, Talman (Sweet), Wealthy, and Whitney (No. 20). Varieties which will yield cider of fair quality are Antonovka, Cross, McMahon, Northwestern (Greening), Peerless, Swaar, University, Utter (Red), and Wolf River. Cider from these will not be of quite as high quality as cider from the varieties in the first list, but none of them yield a cider of poor quality. Cider from Duchess (Oldenburg), Hibernal, Longfield and Patten (Greening) generally is of poor quality or too sour.

Sorting and Washing

The apples should be sorted before grinding in order to discard wormeaten and decaying ones. Decayed spots in otherwise usable apples may be cut away

if it is desirable to make use of the sound portion. The amount of time and help available will determine if this can be done. To include decayed or wormy fruit will spoil the flavor of the cider. It is advisable to wash the apples before grinding. If they are dirty, washing is necessary to avoid an earthy flavor in the cider, and washing will always remove a considerable quantity of dirt which is not evident in a casual examination. Discarding the culls and washing the good apples in an old washtub will take very little time. To cut out decayed spots will take a little longer, but may be worth the trouble at times when apples are scarce.

Grinding

After sorting and washing, the apples are ready for grinding. If possible, work in a screened room to avoid flies, and wash the press occasionally with clean water, as cleanliness is one of the chief factors leading to success in cider-making. Any type, size or make of hand-operated machine can be used. However, the size of the machine should be proportionate to the quantity of fruit to be used. Adjust the grinders so that the apples will be ground as finely as possible in order to secure the maximum yield of juice. Coarsely ground particles will not give up all the juice in them when pressed.

Pressing

When pressing, work the screw in the press down as far as it will go. If a barrel or drum press is used, it may be found best to use a clean grain sack to confine the pomace, as this will prevent the rather unpleasant "squirting" of pomace from the drum and make it possible to apply effectively a much greater pressure. To catch the cider, either wooden or common enamel pails should be used, as the acid in the cider may act upon tin or iron, producing undesirable flavors or discoloration of the cider.

Market Your Apples of Poorer Grades

IN THE FORM OF

CIDER

AND

VINEGAR

Good markets for both can be built
up without much difficulty

Write to the Office of Publications, University Farm, St. Paul, for Bulletin No. 41, which tells how to make both products.

Forty pounds of apples (a bushel basket full) will yield from 2 to 3 gallons of cider, depending on the variety and the grinding and pressing.

Handling Sweet Cider

Pour cider into clean barrels or casks, using a funnel and strainer. It is important to use clean casks, either new or sterilized with steam, as old or dirty containers will add undesirable flavors to the cider. For immediate sale as sweet cider there is nothing more to be done except market the cider. If it is desired to prevent fermentation for a short time it is permissible to add one-tenth of one per cent benzoate of soda to the cider, if for bulk handling. The use of this preservative is not permissible in bottled ciders. Whenever a ready market can be found for sweet cider this generally will be found the most convenient method for the disposal of it.

Handling Cider for Vinegar-Making

If the cider is to be made into vinegar there are several steps which are essential and which must be followed carefully to insure the desired results. After pressing, the cider should be put in new or sterilized barrels, filling the barrels not more than two-thirds or three-fourths full in order that air may have access to the cider. The bunghole should then be loosely plugged with cotton, preferably contained in cheesecloth to facilitate handling. This will admit air and keep out insects and dust. If better air circulation is desired, inch holes can be bored in each head at the top and these holes plugged with cotton or covered with fine mesh wire screen.

Alcoholic Fermentation—The first fermentation or "working" of the cider may often be accelerated by adding to each five gallons of cider one cake of compressed yeast. The yeast should be mixed smoothly with water or cider, and after it is poured into the cider in the barrel they should be mixed thoroughly. Enough wild yeast may at times get into the cider that the addition of more yeast may have little or no effect, but the addition is

relatively inexpensive, does no harm, and generally will make the fermentation certain. This first working is caused by the action of yeast changing the sugars in the cider to alcohol and is often called the alcoholic fermentation to distinguish it from the subsequent vinegar fermentation. This fermentation will go on most satisfactorily if the temperature is kept between 65 and 75 degrees, Fahrenheit. The action will be very rapid for a time but will gradually quiet down and in a few weeks will have ceased. The barrels of cider can be kept in a sunny place while the fermentation is going on. Outdoor temperatures in September and early October are higher than cellar temperatures and the fermentation will proceed more rapidly than in a cellar unless the cellar is heated.

Rack Into Clean Barrels—When the cider is quiet the clear liquid should be "racked" or syphoned off into clean barrels in order to get rid of the sediment. This sediment may not be harmful, but at times it does seriously interfere with the proper behavior of the cider and it is always best to be rid of it at this stage. If the cider has been kept outdoors, this racking gives an excellent opportunity for getting it into the cellar by easy stages in pails and avoiding the handling of heavy barrels. The clear liquid, now in the stage generally known as "hard cider," should be run into sterilized or new barrels, filling as before not more than three-fourths full, and the bunghole closed with a cotton plug. Do not, under any circumstances, use a barrel which previously has been used for vinegar without thoroughly sterilizing it with steam or boiling water. An old barrel commonly contains bacteria and molds which may cause very objectionable flavors or actually destroy the acetic acid of the vinegar, leaving a worthless liquid.

Acetic Fermentation—At this stage of the process the alcohol in the hard cider is changed by the action of vinegar-forming bacteria into acetic acid, which gives the characteristic sour taste to

vinegar. To secure the best results the liquid should be kept, as before, at a temperature between 65 and 75 degrees Fahrenheit. The formation of acid goes on more rapidly at these higher temperatures than would be the case if the cider were kept in a cold cellar, the finished vinegars commonly being ready for use or sale within six months from pressing. If kept cold, the full strength of the vinegar may not be reached for a much longer time. In experiments conducted at University Farm, vinegar of standard strength (4 per cent acetic acid) was frequently secured in two and a half months. Long storage is not a sure means of securing standard strength, as some varieties will not gain vinegar strength in this way.

Value of a Vinegar "Starter"—The change from alcohol to acetic acid may be accelerated also by adding to the cider a small quantity of good quality vinegar as a "starter." Authorities differ somewhat as to how much vinegar to use, but from two to four quarts for thirty gallons will generally be sufficient, and good vinegar has been obtained at this station by using as little as one pint to thirty gallons, although there is no evidence that this result was due entirely to the starter. The object in adding the vinegar is to be certain that some of the vinegar-forming bacteria will be present in the barrel. Enough bacteria may get into the cider by natural means to cause a very satisfactory fermentation, but as in adding yeast to the sweet cider, the vinegar starter makes the proper fermentation more certain.

Variety Recommendations

Apple varieties grown in Minnesota have been tested to determine their value for vinegar-making, and it is now possible to group the varieties into classes on this basis.

Varieties which can be considered dependable for vinegar-making are: Anisim, Charlamoff, Cross, Hibernal, McMahon, Maiden Blush, Okabena, Swaar, Talman (Sweet), Utter (Red), Virginia (Crab), Wealthy, and Wolf River. All of these

should produce vinegar of standard strength, used either separately or in a mixture with others of the group.

Varieties which apparently will not produce standard vinegar in cask fermentation are: Duchess (Oldenburg), Excelsior, Florence (Crab), Longfield, Red Wine, and Whitney (No. 20). Patten (Greening) probably should be included in this list, as it has behaved very erratically, generally not producing a standard vinegar.

Antonovka, Gilbert, Northwestern (Greening), Peerless, University, and Yellow Transparent may produce vinegar strong enough for home use, but not of marketable strength, and they are not safe varieties to use if the vinegar is to be sold.

Handling the Finished Vinegar

When the vinegar has reached the point where a test will show at least 4 per cent of acetic acid, the clear liquid should be racked off into clean barrels. This time the barrels should be filled full, the bung driven in tight to exclude air, and then placed in a cold cellar. In this way any further action in the liquid is checked and the vinegar kept from spoiling.

Test Vinegar Before Selling

The vinegar may be sold at any time after the fermentation is complete, but if sold in quantity it should be tested to see if it has the proper strength as required by law. The law in Minnesota requires that vinegars offered for sale shall contain at least 4 per cent of acetic acid. The tests may be made by the vinegar maker if he so desires, but the State Dairy and Food Commission will test free of charge all samples sent to them, or deputized inspectors may call if a request is sent to the Commission. There are provisions in the law specifying the amounts of solids and ash which the vinegar must contain, but any vinegar properly and honestly made will meet the requirements on these points.

Cost of Production

Considering all the items of cost, sweet

cider can be produced for from 16½ to 24 cents per gallon, the exact cost depending upon the value of the apples, the cost of handling and pressing, the yield, interest and depreciation charges on equipment, and the cost of marketing. Good management usually can keep the cost figure close to the minimum given above. With sweet cider generally selling for about 40 cents per gallon, a fair margin of profit is possible from cull apples which usually are considered of little or no value.

In vinegar-making the cost will run a cent or two per gallon higher than for sweet cider, but the product is more durable.

Sweet Cider or Vinegar?

If vinegar-making costs a cent or two more per gallon than sweet cider, it is evident that the advantage in selling lies with the sweet cider as the returns come more quickly and the net profit will be a little higher. Also, there will not be

the necessity of watching the vinegar-making process and guarding against unfavorable conditions in the cellar. However, to make the cider into vinegar gives the possibility of a sale when no market can be found for sweet cider. As sweet cider can not be kept long, the marketing time is necessarily limited and this more or less limits the quantity which can be produced with safety. In contrast to this, good vinegar will keep for a long time if handled properly, so there is practically no limit to the marketing time. For this reason a much larger quantity can be made with reasonable assurance that all can be sold. The apple grower must decide which product best meets his conditions. A ready market usually can be built up for either sweet cider or vinegar and the grower can thereby secure a profitable method of disposal for a poor grade of fruit, which might otherwise be wasted.

SUGAR BEET SYRUP*

By J. J. WILLAMAN, DIVISION OF AGRICULTURAL BIOCHEMISTRY

Growing the Beets

Any good garden soil is suitable for sugar beets. The seeds are planted when the ground has become permanently warm, in rows 18 or 20 inches apart, and covered rather thinly. After the plants have reached a convenient size, they should be thinned to stand about 10 inches apart. Thorough and frequent cultivation is necessary for the production of beets of high sugar content.

Harvesting

When the leaves assume a yellowish tinge, and the roots can be pulled from the ground almost free from dirt, they are ready to harvest. Good syrup can be made only from fully mature beets. The roots are pulled or dug and the leaves cut off at the crown. The roots can be made into syrup at once, or they may be stored for several months if more convenient. They are most easily stored by throwing them into a pile and covering them with

soil. At first the covering may be light, but later should be heavy enough to prevent freezing.

Preparing the Roots for Syrup

The beets should be scrubbed free of dirt, then the crown cut off at the point of the lowest leaf scar. This upper portion of the beet contains such a large amount of mineral material that it imparts a bad taste to the syrup. The roots are then cut into slices as thin as possible. A kraut cutter fastened over a barrel, or a rotary vegetable slicer, or even a sharp carving knife will do the work.

Extraction of the Sugar

The slices should be put in a barrel or wash boiler, covered with boiling water (about 10 gallons of water for the slices from a bushel of beets), and allowed to stand for about an hour, the container

*Extract from Special Agricultural Extension Bulletin No. 36.

being blanketed with burlap or rugs to retain the heat. The beets will cool the water to about 165 degrees Fahrenheit, the proper temperature for extraction. The slices must not be boiled in this water. The water is then drawn off and strained through cloth into a kettle or wash boiler for evaporation.

Evaporation

The boiling down should proceed slowly, and all scum be carefully removed as fast as formed. Scorching, of course, must be strictly avoided. When the syrup has been sufficiently concentrated, it is poured while hot into sterilized glass jars or tin cans and closed tight. The finishing point of the syrup can be judged by pouring some into a cup, cooling, and noting the consistency, or it can be boiled to 219 degrees Fahrenheit, if a thermometer is at hand. If a hydrometer is used, the finished syrup should read 33 degrees Baume when hot, or 36 degrees when cold. The operator should be particular about getting the proper finishing point, since in using the following receipts success will depend considerably upon having syrup of the consistency given above, which is that of a syrup containing 65 per cent of sugar, and weighing 11 pounds to the gallon.

Yield

A bushel of good beets will make from 3 to 5 quarts of syrup. A row of beets 35 feet long will give a bushel of the roots. The fuel is the only real item of expense involved; hence the making of this product will probably be profitable only where wood is abundant.

Uses of Beet Syrup

The syrup is too dark for a commercial product; but as it is very sweet it can well be used for all cooking purposes where a dark color is immaterial. Most people will relish it as a table syrup. For certain kinds of candy it is excellent.

Recipes for Using Beet Syrup*

The following recipes have been found very successful in the use of beet syrup in place of granulated sugar. One cup

of syrup contains the same amount of sugar and the same sweetening value as a cup of granulated sugar.

Recipes are worked out on a basis of one quart of syrup weighing 44 ounces, or one cup weighing 11 ounces.

*The uses of beet syrup for cooking were thoroughly worked out by Mrs. Jean M. Dorsey and Miss Mabel McDowell of the Division of Home Economics, University of Minnesota.

Steamed Pudding

1 cup sour milk	1 teaspoon soda
1 cup beet sirup	1½ teaspoons salt
½ cup fat	½ cup raisins
1 egg	3 cups white flour
Steam three hours in oiled molds.	

Steamed Brown Bread

1 cup cornmeal	¾ teaspoon soda
1 cup bread crumbs	1 cup sour milk
½ teaspoon salt	½ cup beet syrup

Mix the cornmeal, crumbs, salt and soda. Add to sour milk and molasses. Steam three or four hours. Bread may be dried off in the oven for about fifteen minutes.

Rolled Oats Drop Cookies

1 cup beet syrup	2 cups raw rolled oats
¾ cup melted fat	2½ cups white flour
½ cup sour milk	½ teaspoon cinnamon
¾ teaspoon soda	½ teaspoon cloves
½ cup cut raisins	

Mix the ingredients in the order in which they are given, sifting the dry ingredients together. Drop the cookies by small spoonfuls on oiled pans and bake them in a moderate oven.

Filling

Make a filling of ground raisins, dates, figs or any other fruit. Moisten with beet syrup until proper consistency to spread. Lemon flavoring may be added if desired.

Soft Ginger Cookies

2 cups beet syrup	4 teaspoons soda
1 cup fat	2 eggs
½ cup sour milk	10 cups white flour
3 teaspoons ginger	

Mix first three ingredients, add the beaten eggs, add dry ingredients mixed and sifted.

Gingerbread

1 cup sour milk	1 teaspoon soda
1 egg	½ teaspoon baking powd.
½ cup fat	½ teaspoon salt
1½ cups beet syrup	1 teaspoon cinnamon
2½ cups flour	2 teaspoons ginger
	1 teaspoon allspice

Beat the egg. Add syrup, melted fat or oil, and sour milk. Sift dry ingredients and mix with liquid. One cup raisins may be added if desired. Pour into a shallow oiled pan and bake in a slow oven.

Apple Sauce Cake

$\frac{1}{2}$ cup fat	$\frac{1}{2}$ teaspoon salt
$1\frac{1}{2}$ cups beet syrup	$\frac{1}{2}$ teaspoon cloves
2 cups unsweetened apple sauce	$\frac{1}{4}$ teaspoon nutmeg
$\frac{1}{2}$ teaspoon soda	1 teaspoon cinnamon
3 teaspoons baking powder	5 cups white flour
	1 cup raisins

Mix the ingredients in order given. A half cup

of nuts may be added. Bake in shallow oiled pan in moderate oven.

Spice Cake

$\frac{1}{2}$ cup fat	$\frac{1}{2}$ teaspoon soda
$\frac{3}{4}$ cup beet syrup	1 teaspoon baking powd.
1 egg	$\frac{1}{2}$ teaspoon salt
1 cup sour milk	$\frac{1}{4}$ teaspoon allspice
$2\frac{3}{4}$ cups white flour	$\frac{1}{4}$ teaspoon cloves
$\frac{1}{2}$ cup raisins	$\frac{1}{4}$ teaspoon cinnamon
	$\frac{1}{4}$ teaspoon nutmeg

Mix the syrup and softened fat and add the beaten egg. Mix dry ingredients and add alternately with milk to the first mixture. Bake in moderate oven.

GROWTH OF THE DAIRY INDUSTRY IN MINNESOTA*

The only yearly dairy statistics are those which are compiled from the annual reports of the creameries and cheese factories of the state. In the statistics that are compiled every ten years by the U. S. Census Bureau the field of the dairy industry is more completely covered and their figures are undoubtedly the best obtainable for those periods. Estimates in this line are interesting and when carefully compiled they become valuable reference. The most carefully prepared estimates are those of Prof. T. L. Haecker of the Minnesota Experiment Station. We print below his estimate in full with his introductory remarks:

After consulting all available data and making careful calculations and conservative estimates, I have the following yields and returns for the several periods, showing the growth of the industry.

First, as to the number of cows and yield of milk and butter fat:

Year	Cows	Milk per Cow Lbs.	Butter Fat Per Cow	Butter Per Cow
1890.....	566,000	2,800	110	128
1895.....	677,000	3,000	114	133
1900.....	789,000	3,250	123	143
1905.....	937,000	3,560	135	157
1910.....	1,085,000	3,900	148	173
1912.....	1,125,000	4,000	152	177
1913.....	1,163,000	4,050	153	178
1914.....	1,186,000	4,100	155	180
1915.....	1,210,000	4,150	157	183
1916.....	1,235,000	4,200	159	185
1917.....	1,320,000	4,275	162	189
1918.....	1,368,000	4,325	164	192

Second, as to price of Dairy products and gross returns:

Year	Price of Butter	Earnings per Cow	Gross Returns
1890.....	\$0.12	\$15.40	\$ 8,700,000
1895.....	.15	20.00	13,500,000
1900.....	.18	26.00	20,500,000
1905.....	.22	34.50	32,325,000
1910.....	.27	46.70	50,670,000
1912.....	.30	53.10	59,737,750
1913.....	.30 $\frac{1}{2}$	54.44	63,314,000
1914.....	.30	54.00	64,044,000
1915.....	.30	54.50	65,945,000
1916.....	.31	57.35	77,420,000
1917.....	.40	70.00	92,400,000
1918.....	.47	80.24	109,768,320

The above estimates have reference only to the butter fat and no credit is given to the dairy industry for the milk solids other than fat, which amount in this state to \$11.00 per cow, making in the aggregate for solids not fat \$12,793,000 which added to the value of the butter fat brings the value of the dairy products for the year 1913 to \$76,107,000; 1914, \$77,090,000; 1915, \$79,255,000; 1916, \$91,005,000; 1917, \$110,880,000; 1918, \$124,816,320.

Estimated Value of Minnesota Dairy Products for 1918

Creamery butter, value.....	\$63,383,257.36
Farm butter, estimate.....	2,474,104.85
Creamery by-products, casein, cottage cheese, estimate.....	50,000.00
Factory cheese, estimate.....	1,640,054.42
Cheese on farms.....	21,200.00
Whey.....	2,491,663.00
Skimmilk and buttermilk.....	37,270,886.40
Condensed milk.....	312,000.00
Ice Cream.....	2,083,475.78
Market milk.....	21,801,740.00
Market cream.....	2,180,174.00
Total.....	\$133,708,555.81

*Taken from 1919 Report of James Sorenson, Commissioner, State Dairy and Food Department.

See How Minnesota's *Dairy Industry* Has Grown

	1890	1918
Number of cows.....	566,000	1,368,000
Milk per cow.....	2,800 lbs.	4,325 lbs.
Butterfat per cow.....	110 lbs.	164 lbs.
Butter per cow.....	128 lbs.	192 lbs.
Earnings per cow.....	\$15.40	\$80.24
Gross returns.....	\$8,700,000	\$109,768,320

Estimated Value of Minnesota's
Dairy Products for 1918

\$133,708,555.81

SOME MINNESOTA CREAMERY STATISTICS

Taken from 1919 Report of James Sorenson, Commissioner State Dairy and Food Department.

Creamery Statistics for Thirteen Years

Year	Total No. of Cry's	Co-op.	Ind. and Cent.	Butter Made	Percentage of Increase or Decrease	Value of Butter
1906.....	726	555	171	86,217,727	.....	\$18,364,320.06
1907.....	722	527	195	87,144,817	1.07 % increase	21,099,415.86
1908.....	751	566	185	86,579,914	.648% decrease	20,722,749.70
1909.....	796	574	222	90,834,262	4.90 % increase	24,557,434.57
1910.....	750	560	190	95,668,216	5.32 % increase	26,946,296.53
1911.....	784	606	178	98,984,789	3.46 % increase	24,626,763.23
1912.....	864	621	243	116,051,878	17.24 % increase	29,040,975.43
1913.....	852	614	238	123,117,912	6.08 % increase	34,955,884.91
1914.....	850	622	228	120,806,398	1.87 % decrease	33,603,847.78
1915.....	865	655	210	126,150,665	4.42 % increase	35,591,816.20
1916.....	847	646	201	132,390,172	4.94 % increase	41,011,719.89
1917.....	841	643	198	122,104,899	.776% decrease	49,214,876.15
1918.....	823	630	193	133,059,683	.089% increase	63,383,257.36

Butter Made:	1914	1915	1916	1917	1918
Co-operative Creameries.....	74,079,146	76,767,006	79,815,936	75,325,732	84,235,939
Individual Creameries.....	15,764,091	17,615,802	16,275,411	12,919,109	13,905,766
Centralized Creameries.....	30,856,398	31,767,857	36,298,825	33,860,054	34,917,978

40 of the Individual Creameries are Centralizers.

1918 Creamery Statistics

Number of creameries.....	823	Number pounds butter made.....	133,059,683
Number of patrons.....	119,202	Average per cent overrun.....	23.31
Number cows contributing milk to creameries.....	1,008,040	Average price paid patrons per pound for butterfat.....	\$0.5272
Number pounds milk.....	221,800,695	Amount paid patrons.....	\$56,893,193.19
Number pounds cream.....	288,102,612	Average price received for butter per pound.....	\$0.4763
Number pounds butterfat.....	107,901,736	Running expenses.....	\$4,194,752.56
		Received for creamery butter.....	63,383,257.36

For Every Home—

A vegetable garden.
A small fruit garden.
A small apple and plum orchard.
Plantings of trees, shrubs and flowers.

For Every Farm—

A shelter belt of deciduous and evergreen trees.

For Every School—

Grounds adorned with trees, shrubs and flowers.
The study of gardening.

Suitable plantings of trees on all highways.

Public parks and playgrounds for every village and city.

Commercial production of vegetables, fruits, nursery stock, seeds and flowers.

Originating of better varieties of fruits by the planting of seeds.

Eradication of injurious insects and plant diseases.

The foregoing are the *ideals* of the *Minnesota State Horticultural Society*, which the *Agricultural Extension Division* of the University of Minnesota and *Minnesota Farmers' Institutes* will do everything in their power to help the Society to realize.





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